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SESSIONAL PAPERS

VOLUME 12

PART 2

SECOND SESSION OF THE TWELFTH PARLIAMENT

OF THE

DOMINION OF CANADA

SESSION 1912-13

VOLUME XLVII

307354

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Fifth Census of Canada, 1911—Manufactures for 1910 as enumerated in June, 1911.

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1. Report of the Auditor General for the year ended 31st March, 1912 Volume 1, Parts A to J. Volume II, Parts K to U. Volume III, Parts V to Y. Presented by Hon. Mr. White, 14th January, 1913.

Printed for distribution and sessional papers.

CONTENTS OF VOLUME 2.

2. The Public Accounts of Canada, for the fiscal year ended 31st March, 1912. Presented by Hon. Mr. White, 26th November, 1912.

Printed for distribution and sessional papers.

3. Estimates of sums required for the service of the Dominion for the year ending 31st March, 1914. Presented by Hon. Mr. White, 3rd February, 1913.

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4. Supplementary Estimates of sums required for the service of the Dominion for the year ending on the 31st March, 1913. Presented by Hon. Mr. White, 10th March, 1913.

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5. Supplementary Estimates of sums required for the service of the Dominion for the year ending on 31st March, 1914. Presented by Hon. Mr. White, 20th May, 1913.

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6. List of Shareholders in the Chartered Banks of the Dominion of Canada as on December 31, 1911. Presented by Hon. Mr. White, 26th November, 1912.

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7. Report on dividends remaining unpaid, unclaimed balances and unpaid drafts and bills of exchange in Chartered Banks of the Dominion of Canada, for five years and upwards prior to 31st December, 1911. Presented by Hon. Mr. White, 26th November, 1912.

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8. Report of the Superintendent of Insurance for year ended 1912. Presented by Hon. Mr. White.. .. ..*Printed for distribution nd sessional papers.*

9. Abstract of Statements of Insurance Companies in Canada for the year ended 1912. Presented by Hon. Mr. White.. .. ..*Printed for distribution and sessional papers.*

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10. Report of the Department of Trade and Commerce for the fiscal year ended 31st March, 1912. (Part I.—Canadian Trade). Presented by Hon. Mr. Foster, 30th January, 1913. *Printed for distribution and sessional papers.*

10*a*. Report of the Department of Trade and Commerce, for the year ended 31st March, 1912. (Part II.—Canadian Trade with (1) France, (2) Germany, (3) United Kingdom, and (4) United States). Presented by Hon. Mr. Foster, 12th December, 1912. *Printed for distribution and sessional papers*

10*b*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March. 1912. (Part III.—Canadian Trade with Foreign Countries, except France, Germany, the United Kingdom and United States). Presented by Hon. Mr. Foster, 15th January, 1913.. .. ..*Printed for distribution and sessional papers.*

10*c*. Report of the Department of Trade and Commerce, for the fiscal year ended 31st March, 1912. (Part IV.—Miscellaneous Information). Presented by Hon. Mr. Reid. 17th February, 1913.. ....*Printed for distribution and sessional papers.*

10*d*. Report of the Board of Grain Commisioners for Canada. Presented by Hon. Mr. Foster, 3rd February, 1913.. .. ..*Printed for distribution and sessional papers.*

10*e*. Report of the Department of Trade and Commerce for the fiscal year ended 31st March 1912. (Part VI.—Subsidized Steamship Services). Presented, 1913. *Printed for distribution and sessional papers.*

10*f*. Report of Trade and Commerce for fiscal year ended 31st March, 1912. (Part VII.—Trade of Foreign Countries, Treaties and Conventions). Presented, 1913. *Printed for distribution and sessional papers*

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11. Report of the Department of Customs for the year ended 31st March, 1912. Presented by Hon. Mr. Reid, 28th November, 1912—*Printed for distribution and sessional papers.*

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13. Report of the Department of Inland Revenue for year ended 31st March, 1912. (Part II.—Inspection of Weights and Measures, Gas and Electricity). Presented by Hon. Mr. Nantel, 25th November, 1912.. .. ..*Printed for distribution and sessional papers.*

14. Report of the Department of Inland Revenue for year ended 31st March, 1912. (Part III.—Adulteration of Food). Presented by Hon. Mr. Nantel, 25th November, 1912. *Printed for distribution and sessional papers.*

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16. Report of the Director and Officers of the Experimental Farms for the year ending 31st March, 1912. Presented by Hon. Mr. Burrell, 14th January, 1913.
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17. Criminal Statistics for the year ended 30th September, 1911, (Appendix of the Report of the Minister of Agriculture, for the year 1911). Presented by Hon. Mr. Borden, 2nd June, 1913... .. ..*Printed for distribution and sessional papers.*

18. Return of the Twelfth General Election for the House of Commons of Canada, held on the 14th and 21st of September, 1911. Presented by Hon. The Speaker, 27th November, 1912.. .. ..*Printed for distribution and sessional papers.*

18a. Return of By-Elections (Twelfth Parliament) for the House of Commons of Canada, held during the year 1912. Presented by Hon. The Speaker, 10th March, 1913.
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19. Report of the Minister of Public Works on the works under his control for the fiscal period ended 31st March, 1912. Part I. Presented by Hon. Mr. Rogers, 4th December, 1912. Part II. Ottawa River Storage and Geodetic Levelling.
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21. Forty-fifth Annual Report of the Department of Marine and Fisheries, for the fiscal year 1911-1912—Marine. Presented by Hon. Mr. Hazen, 16th December, 1912.
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21a. Eleventh Report of the Geographic Board of Canada, for the year ending 30th June, 1912. Presented by Hon. Mr. Hazen, 11th April, 1913.
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21c. Supplement to Forty-fifth Report of the Department of Marine and Fisheries, for fiscal year 1911-12,—Marine Branch—Influence of Icebergs and Land on the temperature of the Sea. Presented by Hon. Mr. Hazen, 17th February, 1913.
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22. Forty-fifth Annual Report of the Department of Marine and Fisheries, 1912,—Fisheries. Presented by Hon. Mr. Hazen, 5th December, 1912.
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26. Summary Report of the Geological Survey Branch of the Department of Mines, for the calendar year 1912. Presented by Hon. Mr. Roche, 29th November, 1912.
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28. Report of the Royal Northwest Mounted Police, 1912. Presented by Hon. Mr. Borden, 14th January, 1913.. .. ..*Printed for distribution and sessional papers.*

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29*b*. Report of the work of the Archives Branch of the Department of the Secretary of State, for the year 1912. Presented by Hon. Mr. Coderre, 2nd June, 1913.
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30. The Civil Service List of Canada, 1912. Presented by Hon. Mr. Coderre, 3rd December, 1912.. .. ..*Printed for distribution and sessional papers.*

31. Fourth Annual Report of the Civil Service Commission of Canada for the period from 1st September, 1911, to 31st August, 1912. Presented by Hon. Mr. Coderre, 24th January, 1913.. .. ..*Printed for distribution and sessional papers.*

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34. Report of the Minister of Justice as to Penitentiaries of Canada, for the fiscal year ended 31st March, 1912. Presented by Hon. Mr. Doherty, 27th November, 1912.
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35. Report of the Militia Council for the fiscal year ending 31st March, 1913. Presented by Hon. Mr. Hughes, 14th January, 1913. ..*Printed for distribution and sessional papers.*

36. Report of the Department of Labour for the fiscal year ending 31st March, 1912. Presented by Hon. Mr. Crothers, 28th November, 1912.
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36*a*. Fifth Report of the Registrar of Boards of Conciliation and Investigation of the proceedings under "The Industrial Disputes Investigation Act, 1907," for the fiscal year ending 31st March, 1912. Presented by Hon. Mr. Crothers, 28th November, 1912.
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38. Report of the Department of the Naval Service, for the fiscal year ending 31st March, 1912. Presented by Hon. Mr. Hazen, 28th November, 1912.
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39. "Miscellaneous Unforeseen Expenses," from the 1st April, to the 21st November, 1912, in accordance with the Appropriation Act of 1912. Presented by Hon. Mr. White, 25th November, 1912... .. ..*Not printed*

40. Statement of Treasury Board over-rulings, under Section 44, Consolidated Revenue and Audit Act. Presented by Hon. Mr. White, 26th November, 1912... .. ..*Not printed.*

41. Statement in pursuance of Section 17 of the Civil Service Insurance Act, for the year ending 31st March, 1912. Presented by Hon. Mr. White, 26th November, 1912.
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42. Statement of Receipts and Expenditures of the Ottawa Improvement Commission to 31st March, 1912. Presented by Hon. Mr. White, 26th November, 1912.....*Not printed.*

43. Statement of Governor General's Warrants issued since the last Session of Parliament on account of 1912-13. Presented by Hon. Mr. White, 26th November, 1912.
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44. Statement of Superannuation and Retiring Allowances in the Civil Service during the year ending 31st December, 1912, showing name, rank, salary, service, allowance and cause of retirement of each person superannuated or retired, also whether vacancy is filled by promotion or by appointment, and salary of any new appointee. Presented by Hon. Mr. White, 26th November, 1912.. .. ..*Not printed*

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45. Return (in so far as the Department of the Interior is concerned) of copies of all Orders in Council, plans, papers and correspondence relating to the Canadian Pacific railway, which are required to be presented to the House of Commons, under a Resolution passed on 20th February, 1882, since the date of the last return, under such Resolution. Presented by Hon. Mr. Roche, 26th November, 1912.. .. .. .. *Not printed.*

45*a*. Return to lands sold by the Canadian Pacific Railway Company during the year which ended on the 1st October, 1912. Presented by Hon. Mr. Roche, 14th January, 1913.. .. .. *Not printed*

45*b*. Return to an Address to His Royal Highness the Governor General of the 27th January, 1913, for a copy of all applications made by the Canadian Pacific Railway Company for authorization to make new issue of stock, addressed to the Governor in Council, and of all correspondence with regard to the same. Presented 16th April, 1913, by Sir Wilfrid Laurier.. .. .. *Not printed*

46. Return to an Order of the House of the 18th March, 1912, for a copy of all reports made by the Inspector of Agents for placing Immigrants, both domestic servants and farm labourers, in Ontario and Quebec, during the years 1910 and 1911. Presented 27th November, 1912, by Mr. Sutherland.. .. .. *Not printed.*

47. Return to an Order of the House of the 11th March, 1912, for a copy of all letters, telegrams and other papers in connection with complaints of whatever nature against Commission Agents for placing farm labourers in Ontario, also officials connected with any agency in Ontario, during the year 1910 and 1911. Presented 27th November, 1912 by Mr. Sutherland.. .. .. *Not printed.*

48. Copy of Order in Council No. P. C. 1275, dated 13th May, 1912, "Award of compensation to men belonging to the Royal Canadian Navy, who may be permanently disabled though injuries or illness contracted during drill, training or on duty." Presented by Hon. Mr. Hazen, 27th November, 1912.. .. .. *Not printed.*

48*a*. Copies of plans included in the tender of Messrs. Cammel, Laird & Company, dated 29th April 1911, for the construction of ships for the Canadian Naval Service. Presented by Hon. Mr. Hazen, 18th December, 1912.. .. .. *Not printed.*

48*b*. An Act respecting the Naval Service of Canada." (Copy of Order in Council, No. P. C. 126 dated 20th January, 1913, "Amendment to the Regulations for the Entry of Naval Cadets)." Presented by Hon. Mr. Hazen, 4th February, 1913.. .. *Not printed.*

49. Regulations under "The Destructive Insect and Pest Act." Presented by Hon. Mr. Burrell, 28th November, 1912.. .. .. *Not printed.*

50. Statement of the affairs of the Royal Society of Canada, for the year ended 30th April. 1912. Presented by Hon. Mr. White, 29th November, 1912.. .. .. *Not printed.*

51. Ordinances of the Yukon Territory passed by the Yukon Council in the year 1912. Presented by Hon. Mr. Coderre, 3rd December, 1913.. .. .. *Not printed*

52. Return of Orders in Council which have been published in the *Canada Gazette*, between 1st August, 1911, and 30th September, 1912, in accordance with the provisions of Section 77 of the Dominion Lands Act, Chapter 20 of the Statutes of Canada, 1908. Presented by Hon. Mr. Roche, 5th December, 1912.. .. .. *Not printed.*

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52*a*. Return of Orders in Council passed between the 1st August, 1911, and 30th September, 1912, in accordance with the provisions of Section 5 of the Dominion Land Survey Act, Chapter 21, 7-8 Edward VII. Presented 5th December, 1912, by Hon. Mr. Roche. *Not printed.*

52*b*. Return of Orders in Council which have been passed and published in the *Canada Gazette* and in the British Columbia *Gazette*, between 1st August, 1911, and 30th September, 1912, in accordance with provisions of Subsection (*d*) of Section 38 of the regulations for the survey, administration, disposal and management of Dominion Lands within the 40-mile Railway Belt in the Province of British Columbia. Presented by Hon. Mr. Roche, 5th December, 1912.. .. ..*Not printed*

52c. Return to an Order of the House of the 24th February, 1913, for a copy of all regulations issued by the Minister of the Interior, relating to the disposition of Dominion lands between 8th April, 1905, and 12th October, 1911. Presented by Hon. Mr. Roche. 25th March, 1913.. .. ..*Not printed.*

53. A detailed statement of all bonds or securities registered in the Department of the Secretary of State of Canada, since last return (28th November, 1911) submitted to the Parliament of Canada under Section 32 of Chapter 19, of the Revised Statutes of Canada, 1906. Presented by Hon. Mr. Coderre, 4th December, 1912.. .. ..*Not printed.*

54. Annual Return respecting Trade Unions under Chapter 125, R.S.C., 1906. Presented by Hon. Mr. Coderre, 4th December, 1912.. .. ..*Not printed.*

55. Deliberation of the Canada-West Indies Conference, and Agreement between Canada and certain of the West India Colonies. Presented by Hon. Mr. Foster, 4th December, 1912.. .. ..*Printed for distribution and sessional papers*

56. Orders in Council passed between the 1st August, 1911, and 30th September, 1912, in accordance with the provisions of the Rocky Mountains Park Act, Chapter 60, Revised Statutes of Canada, 1906. Presented by Hon. Mr. Rogers, 4th December, 1912. *Not printed.*

56*a*. Return of Orders in Council passed between the 1st August, 1911, and 30th September, 1912, in accordance with the provisions of the Forest Reserves and Park Act, Section 19, of Chapter 10, 1-2 George V. Presented by Hon. Mr. Roche, 5th December, 1912. *Not printed.*

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57. Report of the Public Service Commission. Presented by Hon. Mr. Borden, 9th December, 1912. Parts I, II, and III.. .. .. ..*Printed for distribution and sessional papers.*

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57*a*. Report on the organization of the Public Service of Canada, by Sir George Murray. Presented by Hon. Mr. Borden, 18th December, 1912. *Printed for distribution and sessional papers.*

58. Report of the proceedings for the preceding year of the Commissioners of Internal Economy of the House of Commons, pursuant to Rule 9. Presented by Hon. The Speaker, 9th December, 1912.. .. ..*Not printed.*

59. Schedules of Trade Transactions between the West Indies and Canada, the United States and the United Kingdom, compiled from the West Indian blue books and statistics. Presented by Hon. Mr. Foster, 12th December, 1912. *Printed for distribution and sessional papers.*

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59*a*. Trade Statistics of Imports and Exports in possession of the Government, *re* British West Indies. (*Senate*).. .. ..*Not printed.*

60. Return showing correspondence concerning the calling for tenders for the Ships of War of Canada, together with copies of tenders. Presented by Hon. Mr. Hazen, 12th December, 1912.. .. ..*Not printed.*

61. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, telegrams, reports and documents relating to the dismissal of John R McDonald, Heatherton, Antigonish County, as Indian agent for the district including the Counties of Antigonish and Guysborough, and the appointment of his successor. Presented 4th January, 1913.—*Mr. Chisholm* (*Antigonish*).. .. ..*Not printed.*

61*a*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Dr. C. P. Bissett, Physician to the Indians at Salmon River, Richmond County, N.S. Presented 14th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*b*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Michael Murphy, postmaster at Point Micheau, Richmond County, N.S. Presented 4th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*c*. Return to an Order of the House of the 9th December, 1912, for copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of David A. McLeod, Postmaster at Cleveland, Richmond County, N.S. Presented 14th January.—*Mr. Kyte*.. .. ..*Not printed.*

61*d*. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, letters, complaints, telegrams, reports, and other documents in the possession of the Post Office Department relating to the dismissal of John Milward, Postmaster at Stormont, Guysborough County, N.S. Presented 14th January, 1913.—*Mr. Sinclair.*
Not printed.

61*e*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents, relating to the dismissal of Kenneth F. McAskill, Postmaster at Loch Lomond, Richmond County, N.S. Presented 14th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*f*. Return to an Address to His Royal Highness the Governor General of the 25th March, 1912, for a copy of all letters, telegrams, memorandums and Orders in Council, relating to the dismissal of Mr. W. W. Hayden, late wharfinger of the government wharf at Digby, Nova Scotia. Presented 14th January, 1913.—*Mr. MacLean* (*Halifax*).
Not printed.

61*g*. Return to an Order of the House of the 11th December, 1912, for a copy of all complaints and charges made against W. B. Langley, assistant at Lobster Hatchery, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal and the appointment of a successor. Presented 14th January, 1913.—*Mr Sinclair*.. .. ..*Not printed.*

61*h*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Fred. E. Cox, engineer lobster hatchery at Isaac's Harbour, Guysborough County, N.S., and of the evidence taken and report of investigation held by H. P. Duchemin in regard to the same. Presented 14th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*i*. Return to an Order of the House of the 11th December, 1912, for a copy of all complaints and charges made against Simon Hodgson, engineer lobster hatchery at Isaac's Harbour, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal and the appointment of a successor. Presented 14th January 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61j. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Henry Henlow, chief engineer at lobster hatchery at Canso, Guysborough County, N.S. Presented 14th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*k*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of H. C. V. LeVatte, harbour master at Louisburg, Cape Breton South, N.S., and of evidence taken and report of investigations held by H. P. Duchemin, in regard to the same. Presented 14th January, 1913.—*Mr. Carroll*.. .. ..*Not printed.*

61*l*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John Cummings, assistant at the lobster hatchery at Isaac's Harbour, Nova Scotia. and of evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same. Presented 14th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*m*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of W. G. Matthews, coxswain, lifeboat crew at Canso, Guysborough County, N.S., and all evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 14th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*n*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relating to the dismissal of Joseph Shean, harbour master at North Sydney, N.S., in the riding of North Cape Breton and Victoria. Presented 14th January, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61*o*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents, relating to the dismissal of George H. Sampson, keeper of the storm signal at Lower L'Ardoise, Richmond County, N.S. Presented 14th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*p*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Alexis Vigneau, captain of the patrol boat at Arichat, Richmond County, N.S. Presented 14th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*q*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, Orders in Council and all other papers or documents in any way relating to the dismissal of Emeri Thivierge, from the position of fisheries inspector for the Counties of Prescott and Russell. Presented 14th January, 1913.—*Mr. Murphy*.. .. ..*Not printed.*

61*r*. Return to an Order of the House of the 9th December, 1912, for a return showing all the public officers of the Inland Revenue Department in the County of St. Jean Iberville, removed by the present Government since 1st May, 1912, together with the names and duties of such persons, the reasons of their dismissal, the nature of the

CONTENTS OF VOLUME 27—*Continued.*

complaints against them, the names of the persons who brought these complaints; also a copy of all correspondence relating thereto, and of the reports of inquiries in the cases where such have been held. Presented 14th January, 1913.—*Mr. Demers.* *Not printed.*

61*s*. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, complaints, petitions, memoranda, notes of evidence, reports of investigations and other documents in the possession of the Department of Inland Revenue regarding the dismissal of J. Fabien Bugeaud, Bonaventure, Quebec, assistant inspector of weights and measures in the Quebec district, and the appointment of his successor or successors, with the names, residence, salaries and duties; also of all documents relating to A. B. Caldwell, New Carlisle, Quebec, joint assistant inspector with J. Fabien Bugeaud, and the duties assigned to him, together with a copy of all recommendations for said new appointment. Presented 14th January, 1913.—*Mr. Marcil (Bonaventure)*.. .. ..*Not printed.*

61*t*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, Orders in Council and all other papers or documents in any way relating to the dismissal of Duncan McArthur, from the Annuities Branch, while the said branch was attached to the Department of Trade and Commerce. Presented 15th January, 1913.—*Mr. Murphy*.. .. ..*Not printed.*

61*u*. Return to an Order of the House of the 26th February, 1912, for a copy of all documents, letters, requests, reports, recommendations and evidence taken under investigation by Dr. Shentliff, relating to the dismissal of Charles O. Jones, postmaster of Bedford, County of Missisquoi. Presented 15th January, 1913.—*Mr. Kay.* *Not printed.*

61*v*. Return to an Order of the House of the 1st April, 1912, for a copy of all letters, telegrams, complaints or other papers or documents in the possession of the Government or any department thereof, relating to the dismissal of Archibald Barss, postmaster, New Harbour, West, Guysborough County, N.S. Presented 15th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*w*. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendation and other reports respecting the dismissal of Dr. A. Allaire as surgeon of the penitentiary of St. Vincent de Paul, and also respecting the payments of his gratuities, superannuation or retiring allowance. Presented 15th January, 1913.—*Mr. Wilson (Laval)*.. .. ..*Not printed*

61*x*. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendations and reports respecting the dismissal of Oscar Beauchamp as warden of the penitentiary of St. Vincent de Paul, and also respecting the payments of his gratuities, superannuation or retiring allowance. Presented 15th January, 1913.—*Mr. Wilson (Laval)*.. .. ..*Not printed.*

61*y*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of John McDonald, freight handler and checker Intercolonial railway at Sydney Mines Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 16th January, 1913.—*Mr. Mackenzie*.. .. ..*Not printed.*

61*z*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents and reports relating to the dismissal of Allan Kinney, of Linwood, Antigonish County, Nova Scotia, a sectionman on the Intercolonial rail-

CONTENTS OF VOLUME 27—*Continued.*

way, and for a statement in detail of the expenses in connection with the investigation of the charges against him. Presented 16th January, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

61*aa*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents and reports relating to the dismissal of Charles Landry, of Pomket, Antigonish county, Nova Scotia, a sectionman on the Intercolonial railway, and for a statement in detail of the expenses connected with the investigation of the charges against him. Presented 16th January, 1913.—*Mr. Chisholm (Antiginish)*.. .. ..*Not printed.*

61*bb*. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, documents, reports, correspondence, &c., relating to the dismissal of Patrick Decoste, an employee on the ferry steamer *Scotia* between Mulgrave and Point Tupper on the Intercolonial railway. Presented 16th January, 1913.. .. ..*Not printed.*

61*cc*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Harry E. McDonald, assistant engineer at St. Peters Canal, Richmond County, N.S Presented 13th January, 1913.—*Mr. Kyte.*

61*dd*. Return to an order of the House of the 9th December, 1912, for a copy of all letters, papers, documents, telegrams, and charges relating to a complaint against Neil Ross sectionman on the Intercolonial railway at West River, County of Pictou, and of the evidence taken at the investigation, of the report of the commissioner thereon, and of all letters, papers or other documents relating to the appointment of his successor. Presented 16th January, 1913.—*Mr. Macdonald*.. .. ..*Not printed.*

61*ee*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents and reports relating to the dismissal of James Armstrong, of Heatherton, Antigonish County, N.S., a sectionman on the Intercolonial railway, and for a statement in detail of the expenses connected with the investigation of the charges against him. Presented 16th January, 1913.—*Mr. Chisholm (Antigonish).* *Not printed.*

61*ff*. Return to an Order of the House of the 4th December, 1912, for a copy of all letters, telegrams and other documents, relating to the dismissal of Thomas J. Gray, as car inspector on the Intercolonial railway at Westville, County of Pictou. Presented 16th January, 1913.—*Mr. Macdonald*.. .. ..*Not printed.*

61*gg*. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, telegrams and reports relating to the dismissal of Colin Macdonald, of James River Station, County of Antigonish, as Intercolonial sectionman, and the appointment of his successor. Presented 16th January, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

61*hh*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of A. T. Gannon, car repairer and inspector Intercolonial railway at North Sydney, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 16th January, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*ii*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents, and reports relating to the dismissal of Huber Myatte, Tracadie, Antigonish County, Nova Scotia, a sectionman on the Intercolonial railway and for a statement in detail of the expenses connected with the investigation of the charges against him. Presented 16th January, 1913.—*Mr. Chisholm* (*Antigonish*). *Not printed.*

61*jj*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents, and reports relating to the dismissal of John McDonnell, Afton Station, Antigonish County, Nova Scotia, a sectionman on the Intercolonial railway, and for a statement in detail of the expenses connected with the investigation of the charges against him. Presented 17th January, 1913.—*Mr. Chisholm* (*Antigonish*).. .. ..*Not printed.*

61*kk*. Return to an Order of the House of the 9th December, 1911, for a copy of all letters, correspondence, documents and reports relating to the dismissal of William Landry, of Pomket, Antigonish County, Nova Scotia, a section foreman of the Intercolonial railway, and for a statement in detail of the expenses connected with the investigation of the charges againt him. Presented 17th January, 1913.—*Mr. Chisholm* (*Antigonish*).. .. ..*Not printed.*

61*ll*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, telegrams and other documents relative to the dismissal of D. J. McDougall, section foreman, Intercolonial railway, Grand Narrows, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 17th January, 1913.—*Mr. McKenzie.* *Not printed.*

61*mm*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Dan. A. Coffey, lockman at St. Peter's canal, Richmond County, N.S., and of the evidence taken and of the reports of investigation held by H. P. Duchemin, in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Also, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of W. A. McNeil, lockman at St. Peter's canal, Richmond County, N.S., and of the evidence taken and of the report of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 17th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*nn*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John P. Meagher, foreman deckhand on steamship *Scotia*, Mulgrave, Guysborough County, N.S., and of all evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 17th January, 1913.—*Mr. Sinclair*.. .. .. ..*Not printed.*

61*oo*. Return to an Order of the House of the 4th December, 1912, for a copy of all letters, telegrams, evidence taken, reports, &c., and of all correspondence between the Postmaster General and officers of his department, and James Gibson, ex-postmaster of Alameda, Sask., in connection with the instructions sent him to hand the office over to E. Cronk. Presented 17th January, 1913.—*Mr. Turriff*.. .. ..*Not printed.*

61*pp*. Return to an Order of the House of the 11th December, 1912, for a copy of all papers, documents and correspondence relating to the dismissal of Captain C. E. Miller from the 75th Regiment. Presented 17th January, 1913.—*Mr. Maclean* (*Halifax*). *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*qq*. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, letters and telegrams relating to the dismissal of J. N. N. Poirier, collector of excise at Victoriaville, Quebec, and also of the inquiry made by N. Garceau, by the Minister of Inland Revenue, and especially of two affidavits given by Ludger Frechette and Joseph Faucher. Presented 17th January, 1913.—*Mr. Brouillard.* *Not printed.*

61*rr*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges correspondence, letters, telegrams, and other documents relative to the dismissal of Abraham Astephen, of North Sydney, N.S., interpreter Immigration Department at North Sydney, N.S., in the riding of North Cape Breton and Victoria. Presented 17th January, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61*ss*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, Orders in Council, and all other papers or documents in any way relating to the dismissal of Robert Dow from the Immigration Branch of the Department of the Interior at Ottawa. Presented 17th January, 1913. —*Mr. Murphy*.. .. ..*Not printed.*

61*tt*. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, correspondence, &c., relating to the dismissal of John Ware of the Immigration Branch of the Interior Department at Halifax, N.S. Presented 17th January, 1913.—*Mr. Maclean (Halifax)*.. .. ..*Not printed.*

61*uu*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges correspondence, letters, telegrams, and other documents relative to the dismissal of Richard Hickey, agent Immigration Department at North Sydney, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same, and a detailed statement of the expenses of such investigation. Presented 17th January, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61*vv*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges correspondence, letters, telegrams, and other documents relative to the dismissal of Dr. J. W. McLean, of North Sydney, N.S., medical examiner, Immigration Department at North Sydney, N.S., in the riding of North Cape Breton and Victoria. Presented 17th January, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61*ww*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John A. McRea, lightkeeper, at Margaree Island, Inverness County, Nova Scotia, of the evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 17th January, 1913.—*Mr. Chisholm (Inverness)*.. .. .. ..*Not printed.*

61*xx*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Thomas Brymer, lightkeeper at Lower L'Ardoise, Richmond County, N.S. Presented 17th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*yy*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges correspondence, letters, telegrams and other documents relating to the dismissal of Dominique Boudrot, buoy contractor, at Petit de Grat, Richmond County, N.S. Presented 17th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*zz*. Return to an Order of the House of the 4th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents concerning the dismissal of Frederick F. Doucet, keeper of the lighthouse at the entrance of the harbour of Caraquet, County of Gloucester, and the nomination of his successsor. Presented 17th January, 1913.—*Mr. Turgeon*.. .. ..*Not printed.*

61*aaa*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of W. H. Henlow, keeper of storm drum, Liscomb, Guysborough County, N.S. Presented 17th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*bbb*. Return to an Order of the House of the 4th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of David Falconer, lightkeeper at Cariboo Island, County of Pictou. Presented 17th January, 1913.—*Mr. Macdonald*.. .. ..*Not printed.*

61*bbb*. Return to an Order of the House of the 4th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of M. Wilson Lawlor, harbour commissioner at North Sydney, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 17th January, 1913.—*Mr. McKenzie.*
Not printed.

61*ddd*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of P. J. McDonald, harbour commissioner at North Sydney, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 17th January, 1913.—*Mr. McKenzie.*
Not printed.

61*eee*. Return to an Order of the House of the 9th December, 1912, for a return showing: 1. The names of all lightkeepers in the Province of Nova Scotia who were dismissed from office or employment since 10th October, 1911, together with the date of each dismissal. Presented 17th January, 1913.—*Mr. Maclean (Halifax)*.. .. ..*Not printed.*

61*fff*. Return to an Order of the House of the 4th December, 1912, for a return showing the detail and number of dismissals from public offices in the Department of Marine and Fisheries to this date in the County of Bonaventure, the names of the dismissed occupants, the reasons for their dismissal, the complaints against such officials and a copy of all correspondence with respect to the same, and of all reports of investigations where such were held; as well as a list of the new appointments made by the department, with names, residences, salaries and duties,and a copy of all recommendations of such appointments. Presented 17th January, 1913.—*Mr. Marcil (Bonaventure).*
Not printed.

61*ggg*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of H. L. Tory, fishery officer at Guysborough, Guysborough County, N.S., and of all evidence taken, and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of the investigation. Presented 17th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*hhh*. Return to an Order of the House of the 4th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents in the possession of the Department of Marine and Fisheries relating to the dismissal of John W. Davis, fishery officer, Guysborough, N.S. Presented 17th January, 1913.—*Mr. Sinclair.*
Not printed.

CONTENTS OF VOLUME 27—*Continued.*

61*jjj*. Return to an Order of the House of the 4th December, 1912, for a copy of all charges correspondence, letters, telegrams and other documents relating to the dismissal of Martin Bourque, lightkeeper at River Bourgeois, Richmond County, N.S., and of the evidence taken and of the report of the investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 17th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*jjj*. Return to an Order of the House of the 4th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Frederick Poirier, buoy contractor, at Descouse, Richmond County, N.S. Presented 17th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*kkk*. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, letters, telegrams and petitions for and against the dismissal of Dr. George Pinault, as medical health officer of the Mic-Mac Indian reserve, at Ste. Anne de Restigouche, Bonaventure County, Quebec, and of all documents relating to the appointment of a successor, with the name, residence, salary and duties of the new appointee. Presented 20th January, 1913.—*Mr. Marcil*.. .. ..*Not printed.*

61*lll*. Return to an Order of the House of the 1st April, 1912, for a copy of all papers, letters, &c., concerning the dismissal of Frederick Veit, employed by the Department of Marine and Fisheries in the County of Gaspé. Presented 20th January, 1913.—*Mr. Lemieux*.. .. ..*Not printed.*

61*mmm*. Return to an Order of the House of the 1st April, 1912, for a copy of all letters, petitions, complaints, declarations and other documents in the possession of the Department of Marine and Fisheries, relating to the dismissal of Mr. Alfred Lalonde, employed in the warehouse of the Government yards at St. Joseph de Sorel and the appointment of his successor. Presented 20th January, 1913.—*Mr. Cardin*..*Not printed.*

61*nnn*. Return to an Order of the House of the 1st April, 1912, for a copy of all letters telegrams, complaints or other papers or documents in the possession of the Government or any department thereof, relating to the dismissal of James Webber, lightkeeper, Tor Bay Point, N.S. Presented 20th January, 1913.—*Mr. Sinclair*.
Not printed.

61*ooo*. Return to an Order of the House of the 1st April, 1912, for a copy of all documents letters, inquiries, reports, evidence, &c., relating to the dismissal or the resignation of Baptiste Desjardins as lighthouse keeper at Kamouraska. Presented 20th January, 1913.—*Mr. Lapointe (Kamouraska)*.. .. ..*Not printed.*

61*ppp*. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, letters, telegrams and other documents relating to the dismissal of Angus Smith, pilot on the steamer *Earl Grey*, and also of all the evidence taken at the latest investigation held in regard to the said complaints, and of the report of the investigation with regard to the same. Presented 20th January, 1913—*Mr. Macdonald*.
Not printed.

61*qqq*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Michael J. Sampson, lightkeeper at Lower L'Ardoise, Richmond County, N.S. Presented 20th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*rrr*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of William Hackett, harbour commissioner at North Sydney, Nova Scotia, in the riding

CONTENTS OF VOLUME 27—*Continued.*

of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin in regard to same, and a detailed statement of the expenses of such investigation. Presented 20th January, 1913.—*Mr. McKenzie.* *Not printed.*

61*sss*. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence and other documents in the possession of the Department of Marine and Fisheries relating to the dismissal of Hormidas Lacasse, as wharfinger on the government wharf at Wendover, County of Prescott, Ontario, and the appointment of his successor. Presented 20th January, 1913.—*Mr. Proulx*.. .. ..*Not printed.*

61*ttt*. Return to an Order of the House of the 9th December, 1912, for a copy of all documents, papers, evidence and correspondence, relating to the dismissal of Geoffrey Gorman, coxswain of the lifeboat station at Herring Cove, Halifax County, N.S. Presented 20th January, 1913.—*Mr. Maclean (Halifax)*.. .. .. *Not printed.*

61*uuu*. Return to an Order of the House of the 10th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Captain George Wetmore, harbour master at Yarmouth, Yarmouth County, N.S., and the same information regarding the appointment of Captain Wetmore's successor, and of all evidence taken and report of investigation held by Charles Lane in regard to the same, also a detailed statement of expenses of such investigation. Presented 20th January, 1913.—*Mr. Law*.. .. ..*Not printed.*

61*vvv*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Stanley Henlow, lightkeeper at Liscomb, Guysborough County, N.S., and of evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 20th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*www*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of H. C. V. LeVatte, fishery officer at Louisburg, Cape Breton South, N.S., and of the evidence taken and reports of investigations held by H. P. Duchemin, in regard to the same. Presented 20th January, 1913.—*Mr. Carroll*.. .. ..*Not printed.*

61*xxx*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Elias M. Boudrot, keeper of storm signal at Petit de Grat, Richmond County, N.S., and of the evidence taken and report of investigation held by H. P. Duchemin in regard to the same and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 20th January, 1913.—*Mr Kyte*.. .. ..*Not printed.*

61*yyy*. Return to an Order of the House of the 10th December, 1912, for a return of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of A. B. Cox, Superintendent of Reduction Works at Canso, Guysborough County, N.S., and of all evidence taken and report of investigation held by H. P Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 20th January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*zzz*. Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against Jeffrey Crespo, sub-collector of Customs at Harbour au Bouche, Antigonish County, Nova Scotia, and of all letters, telegrams, correspondence and reports relating in any way to his dismissal and the appointment of a successor. Presented 20th January, 1913.—*Mr. Chisholm (Antigonish).* *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*aaaa*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, papers, charges and correspondence between the Department of Customs and all other persons regarding the dismissal from office of Thomas Cameron, preventive officer at Andover, N.B., and also of all evidence and reports thereon with reference to the dismissal of the said officer. Presented 20th January, 1913.—*Mr. Michaud.* *Not printed.*

61*bbbb*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of L. W. Pye, customs officer at Liscomb, Guysborough County, N.S., and of all evidence taken and reports of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 20th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*cccc*. Return to an Order of the House of the 9th December, 1912, for a copy of all complaints, accusations, inquiries, reports, correspondence, and of all documents relating to the dismissal of Lucien O. Thisdale, a customs employee at Valleyfield, Quebec, and the appointment of his successor. Presented 20th January, 1913.—*Mr. Papineau.* *Not printed.*

61*dddd*. Return to an Order of the House of the 11th December, 1912, for a copy of all letters, telegrams, correspondence, reports, and other documents relating to the dismissal of Alexander Macdonald of Doctor's Brook, Antigonish County, as sub-collector of customs. Presented 20th January, 1913.—*Mr. Chisholm* (*Antigonish*). *Not printed.*

61*eeee*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Henry Cann, customs official and preventive officer at North Sydney, Nova Scotia, in the riding of North Cape Breton and Victoria. Presented 20th January, 1913.—*Mr. McKenzie*.. .. ..*Not printed*

61*ffff*. Return to an Order of the House of the 10th December, 1912, for a copy of all documents concerning the dismissal of Charles Mennier, customs preventive officer at Marieville, Quebec. Presented 20th January, 1913.—*Mr. Lemieux*.. .. ..*Not printed.*

61*gggg*. Return to an Order of the House of the 5th December, 1912, for a copy of all charges, correspondence, letters, telegrams, instructions, minutes of evidence taken and had on any inquiry investigation had, held or taken, and of all other papers and documents relating to the dismissal of George H. Cochrane, Collector of Customs at the Port of Moncton, New Brunswick; together with a copy of all letters and other correspondence between the Honourable Minister of Customs, and the member representing the County of Westmorland, New Brunswick, in this House, and of all letters, papers, telegrams, recommendations, appointments, or other papers and documents relating to the appointment of a collector of customs to succeed the said George H. Cochrane. Presented 20th January, 1913.—*Mr Emmerson*.. .. ..*Not printed.*

61*hhhh*. Return to an Order of the House of the 22nd January, 1912, for a copy of all correspondence, documents, recommendations and reports respecting the dismissal of C Michaud, postmaster at St. Germain, Kamouraska, and the appointment of his successor. Presented 20th January, 1913.—*Mr. Lapointe* (*Kamouraska*).. ..*Not printed.*

61*iiii*. Return to an Order of the House of the 25th March, 1912, for a copy of all letters, telegrams and other documents, and of all complaints or accusations relating in any manner to the dismissal of Mr. Emile Archambault, letter carrier of Montreal, and a copy of the inquiry, and of the report of the inquiry held. Presented 20th January, 1913.—*Mr. Seguin*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*jjjj*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Norman Morrison, postmaster at Ferguson's Lake, Richmond County, N.S. Presented 21st January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*kkkk*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of D. J. McKillop, postmaster at McKillop, Richmond County, N.S. Presented 21st January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*llll*. Return to an Order of the House of the 22nd January, 1912, for a copy of all correspondence, papers and reports in connection with the investigation recently held at the Ste. Agathe post office, County of Terrebonne. Presented 21st January, 1913.—*Mr. Lemieux*.. .. ..*Not printed.*

61*mmmm*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Bertie Boudrot, lightkeeper at Poulamon, Richmond County, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation, and a copy of all papers relating to the appointment of his successor. Presented 22nd January, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61*nnnn*. Return to an Order of the House of the 1st April, 1912, for a copy of all letters, telegrams and other documents and of all complaints, accusations and requests for inquiry, relating in any manner to the lighthouse keepers of Repentigny, P.Q., Messrs. Leon Rivest, J. B. Lachapelle and Louis Dubois, since 21st September last; also a copy of the inquiry and the report of the inquiry held in the matter. Presented 22nd January, 1913.—*Mr. Seguin*.. .. ..*Not printed.*

61*oooo*. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, telegrams, letters, &c., relating to the dismissal of L. P. Carignan, forest ranger in the constituency of Champlain, Quebec. Presented 24th January, 1913.—*Mr. Maclean (Halifax)*.. .. ..*Not printed.*

61*pppp*. Return to an Order of the House of the 5th December, 1912, for a copy of all correspondence, complaints, petitions, memoranda, notes of evidence, letters, reports of investigations and other documents in the possession of the Department of Customs, relating to the dismissal of James S. Harvey, preventive officer, New Richmond, Quebec; W. L. Kempffer, preventive officer at Paspebiac, Quebec; J. Herbert Sweetman, preventive officer at Port Daniel, Quebec; J. B Le Blanc, preventive officer, at Carleton, Quebec; J. Nadeau, preventive officer, Nouvelle, Quebec, as well as a copy of all recommendations made regarding the appointment of their various successors and the names, salaries, duties and residences, with a copy of their instructions. Presented 24th January, 1913.—*Mr. Marcil*.. .. ..*Not printed.*

61*qqqq*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of William Marsh, preventive officer at Little Pond, Sydney Mines, in the riding of North Cape Breton and Victoria. Presented 24th January, 1913.—*Mr. McKenzie.* *Not printed.*

61*rrrr*. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, letters, telegrams, and petitions, for and against the dismissal of Duncan McDonald, preventive officer of customs at Athelstan, County of Huntingdon; also a copy of the report of investigation and evidence submitted to investigating commissioner. Presented 24th January, 1913.—*Mr. Robb*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*ssss*. Return to an Address to His Royal Highness the Governor General of the 11th December, 1912, for a copy of all papers, documents, orders in council, telegrams, letters, &c., relating to the dismissal from office of Lemuel Bent, late Collector of Customs at Oxford, N.S. Presented 24th January 1913.—*Mr. Maclean (Halifax). Not printed.*

61*tttt*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Pascal Poirier, Collector of Customs at Descouse, Richmond County, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 24th January, 1913.—*Mr. Kyte.. .. ..Not printed.*

61*uuuu*. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, letters, telegrams, reports and other documents concerning the dismissal of Donald J. Hachey, Collector of Customs at Bathurst, County of Gloucester, and the appointment of his successor. Presented 24th January, 1913.—*Mr. Turgeon. Not printed.*

61*vvvv*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, orders in council, and all other papers or documents in any way relating to the dismissal of John Maher, from the service of the Customs Department at Montreal. Presented 24th January, 1913.—*Mr. Murphy.. .. ..Not printed.*

61*wwww*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Peter Fougère, preventive and customs officer at Petit de Grat, Richmond county, N.S., and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 24th January, 1913.—*Mr. Kyte.. .. ..Not printed.*

61*xxxx*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of James Grantmyre, preventive officer at Little Bras D'or, N.S., in the riding of North Cape Breton and Victoria. Presented 24th January, 1913.—*Mr. McKenzie. Not printed.*

61*yyyy*. Return to an Order of the House of the 15th January, 1913, for a return showing all the employees on the Soulanges Canal who have been dismissed from their duties since the 21st September, 1911, by whom each of these employees has been replaced, and for what causes were they dismissed. Presented 27th January, 1913.—*Mr. Boyer.. .. ..Not printed.*

61*zzzz*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Andrew Melville, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Proulx.. .. ..Not printed.*

61*aaaaa*. Return to an Order of the House of 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of George Short, canal bridgetender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Guthrie.. .. ..Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*bbbbb*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of N. Broderick, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. McMillan*.. .. ..*Not printed.*

61*ccccc*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Thomas McLatchie, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Graham*.. .. ..*Not printed.*

61*ddddd*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Elgin McLaughlin, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Emmerson*.. .. ..*Not printed.*

61*eeeee*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Robert Robertson, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Lemieux*.. .. ..*Not printed.*

61*fffff*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of William L. Gladstone, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Pugsley*.. .. ..*Not printed.*

61*ggggg*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Byron VanCamp, locktender at Cardinal, Ontario. Presented 7th January, 1913.—*Mr. Murphy*.. .. ..*Not printed.*

61*hhhhh*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Samuel English, canal bridge tender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

61*iiiii*. Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Edward F. Moran, locktender at Cardinal, Ontario. Presented 27th January, 1913.—*Mr. Oliver*.. .. ..*Not printed.*

67*jjjjj*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters correspondence, documents and reports relating to the dismissal of William R. Fougere, of Frankville, Antigonish County, N.S., a sectionman on the Intercolonial railway, and for a statement in detail of the expenses connected with the investigations of the charges against him. Presented 27th January, 1913.—*Mr. Chisholm (Antigonish). Not printed.*

61*kkkkk*. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents and reports relating to the dismissal of John Melanson, of Afton, Antigonish County, N.S., a sectionman on the Intercolonial railway, and for a statement in detail of the expenses connected with the investigation of the charges against him. Presented 27th January, 1913.—*Mr. Chisholm (Antigonish). Not printed.*

61*lllll*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Ronald D. McDonald, fishery overseer, at Broad Cove, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 27th January, 1913.—*Mr. Chisholm (Inverness). Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*mmmmm*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John McLean, fishery officer at Gabarouse, Cape Breton South. N.S., and of evidence taken and reports of investigations held by H. P. Duchemin, in regard to the same. Presented 27th January, 1913.—*Mr. Carroll*.. .. ..*Not printed.*

61*nnnnn*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of A. R. Forbes, fishery overseer at North Sydney, Nova Scotia in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 27th January, 1913.—*Mr. McKenzie.* *Not printed.*

61*ooooo*. Return to an Order of the House of the 15th January, 1913, for a copy of all correspondence, letters, telegrams, complaints, petitions, and other documents concerning the dismissal of Sebastien Savoie, superintendent of the lobster hatchery at Shippigan, Gloucester County, N.B., and the appointment of his successor. Presented 27th January, 1913.—*Mr. Turgeon*.. .. ..*Not printed.*

61*ppppp*. Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of D. S. Hendsbee, weigher, reduction works, Canso, Guysborough County N.S., and of all evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 27th January, 1913.—*Mr. Sinclair*.. .. ..*Not printed.*

61*qqqqq*. Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of M. Muce, lightkeeper at Cheticamp Island, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 29th January, 1913.—*Mr. Chisholm (Inverness)*.. .. .. ..*Not printed.*

61*rrrrr*. Return to an Order of the House of the 15th January, 1913, for a copy of all papers, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Dr. J. D. R. Williams, collector of canal tolls at Cardinal, Ontario, and of the appointment of his successor. Presented 30th January, 1913.—*Mr. McMillan*.. .. ..*Not printed.*

61*sssss*. Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of John W. Bohan, preventive officer at Bath, Carleton County, N.B. Presented 3rd February, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

61*ttttt*. Return to an Order of the House of the 15th January, 1913, for a copy of all papers documents, correspondence, &c., relating to the dismissal of J. V. Smith, sub-collector of customs at Wood's Harbour, Shelburne County, N.S. Presented 3rd February, 1913. —*Mr. Law*.. .. ..*Not printed.*

61*uuuuu*. Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of John Y. Fleming, customs officer at Debec, Carleton County, N.B. Presented 3rd February, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

61*vvvvv*. Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Matthias Meagher, preventive officer at Debec, Carleton County, N.B. Presented 3rd February, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61*wwwww*. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, letters, telegrams, complaints, and of the evidence given at investigation, if one was held, relating to the dismissal of Mr. A. J. Gosselin, acting preventive officer of customs at St. Albans, Vermont, through the port of St. Armand, County of Missisquoi. Presented 4th February, 1913.—*Mr. Kay*.. .. ..*Not printed.*

61*xxxxx*. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, letters, telegrams, and petitions for and against the dismissal of James W. Bannon, preventive officer of customs at St. Agnes de Dundee, County of Huntingdon also a copy of the report of investigation and evidence, if any, submitted to investigating commissioner. Presented 4th February, 1913.—*Mr. Robb*.. .. ..*Not printed.*

61*yyyyy*. Return to an Order of the House of the 4th December, 1912, for a return showing the number of postmasters that have been dismissed in the County of Pictou since 1st October, 1911; the names of the postmasters who have been appointed to succeed them; the causes of the dismissals and all complaints and correspondence with respect to same, and of all reports of investigation where investigations have been held. Presented 4th February, 1913.—*Mr. Macdonald*.. .. ..*Not printed.*

61*zzzzz*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, orders in council, and all other papers or documents in any way relating to the dismissal of James Murphy from the position of postmaster at Tweed, Ontario. Presented 4th February, 1913.—*Mr. Murphy*.. .. ..*Not printed.*

61 (6*a*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of H. B. Easton, immigration agent at Prescott, Ontario. Presented 4th February, 1913.—*Mr. Murphy*.. .. ..*Not printed.*

61 (6*b*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of B. Hughes, immigration agent at Prescott, Ontario. Presented 4th February, 1913.—*Mr. Oliver*.. .. ..*Not printed.*

61 (6*c*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of George Walsh, immigration agent at Prescott, Ontario. Presented 4th February, 1913.—*Mr. Oliver*.. .. ..*Not printed.*

61 (6*d*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Newton S. Dow, immigration agent at McAdam Junction, York County, N.B. Presented 4th February, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

61 (6*e*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Oliver Hemphill, immigration agent at Debec, Carleton County, N.B. Presented 4th February, 1913.—*Mr. Carvell*.. .. ..*Not printed.*

61 (6*f*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Martin Johnston, preventive officer at Rea Islands, Richmond County, N.S Presented 6th February, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (6*g*). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, letters, telegrams and other documents respecting the dismissal of J. E. Phaneuf, postmaster of St. Hugues, County of Bagot. Presented 6th February, 1913.—*Mr. Marcile*.. .. ..*Not printed*

61 (6*h*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Murdock McCutcheon, postmaster at Sonora, Guysborough County, N.S., and of all evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 6th February, 1913.—*Mr. Sinclair*.. .. ..*Not printed*

61 (6*i*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Duncan Gillies, fishery overseer at Baddeck, C.B., in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 7th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (6*j*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints, accusations, correspondence, petitions and of all documents and reports respecting the dismissal of Antonio Leduc, postmaster of St. Timothée, in the County of Beauharnois and the appointment of his successor. Presented 7th February, 1913.—*Mr. Papineau*.. .. ..*Not printed.*

61 (6*k*). Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of the recommendation to council, the order in council, all correspondence with the government or any member thereof, and of all letters, documents and papers in any way connected with the dismissal of Charles Arthur Bowman from the engineering branch of the Department of Railways and Canals.—*Mr. Clark (Red Deer)*.. .. ..*Not printed.*

61 (6*l*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, evidence, reports, letters, correspondence, &c., relating to the dismissal of Elnathan D. Smith, fishery overseer, Shag Harbour, Shelburne County, N.S. Presented 11th February, 1913.—*Mr. Law*.. .. ..*Not printed.*

61 (6*m*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Donald McAulay, lightkeeper, Plaister, Baddeck Bay, C.B., riding of North Cape Breton and Victoria, and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie.* *Not printed.*

61 (6*n*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, letters, correspondence, &c., relating to the dismissal of John Fredericks, lightkeeper at East Jordan, Shelburne County, N.S. Presented 11th February, 1913.—*Mr. Law*.. .. ..*Not printed.*

61 (6*o*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, letters, correspondence, &c., relating to the dismissal of John Fredericks, wharfinger at East Jordan, Shelburne County, N.S. Presented 11th February, 1913.—*Mr. Law*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (6*p*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, letters, correspondence, &c., relating to the dismissal of John C Morrison, harbour master at Shelburne, N.S. Presented 11th February, 1913.—*Mr. Maclean (Halifax)*.. .. ..*Not printed.*

61 (6*q*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Captain Roderick McDonald, tide waiter, at Big Bras D'Or, riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie.* *Not printed.*

61 (6*r*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of James Maloney, customs officer at Dingwall, riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (6*s*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Hugh D. McEachern, customs officer at north side East Bay, Cape Breton, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (6*t*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, evidence, reports and correspondence relating to the dismissal of Thos. H. Hall, sub-collector of customs at Sheet Harbour, N.S. Presented 11th February, 1913.—*Mr. Maclean (Halifax)*.. .. ..*Not printed.*

61(6*u*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of J. A. McNeil, customs officer at Grand Narrows, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie.* *Not printed.*

61 (6*v*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of George Burchell, custom house officer at Sydney Mines, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie.* *Not printed.*

61 (6*w*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of W. H. Saver, collector of customs at Cardinal, Ont., and the appointment of his successor. Presented 11th February, 1913.—*Mr. McMillan.* *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (6*x*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, telegrams and other documents relative to the dismissal of Captain George Livingstone, custom officer at Big Bras D'Or, Cape Breton, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same and a detailed statement of the expenses of such investigation. Presented 11th February, 1913.—*Mr. McKenzie. Not printed.*

61 (*y*). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, reports and other documents and papers relating to the dismissal of H. Lacasse, as postmaster at Wendover, County of Prescott, Ontario, and the appointment of his successor. Presented 13th February, 1913.—*Mr. Proulx.. ..Not printed*

61 (6*z*). Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence and other papers connected with the removal of Harry A. Drigg, from the position of postmaster at Grassey Lake, Alberta. Presented 13th February, 1913.—*Mr. Buchanan.. .. ..Not printed*

61 (7*a*). Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, memoranda, orders in council, and correspondence relating to the dismissal of A. H. Stratton, late postmaster at Peterborough, Ont. Presented 17th February, 1913.—*Mr. Maclean (Halifax). Not printed*

61 (7*b*). Return to an Order of the House of the 10th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Henry Burrell, postmaster, Yarmouth North, Yarmouth County, N.S., and the same information regarding the appointment of Henry Burrell's successor, and of the evidence taken and report of investigation held by Charles Lane in regard to the same, also a detailed statement of expenses of such investigation. Presented 18th February, 1913.—*Mr. Law.. .. ..Not printed.*

61 (7*c*). Return to an Order of the House of the 4th December, 1912, for a return showing all the postmasters dismissed by the present government in the County of Gloucester. the names of such persons, the reasons for their dismissal, nature of the charges made against them; also a copy of all correspondence connected with it, and reports of investigations in cases where such investigations were instituted. Presented 18th February, 1913.—*Mr. Turgeon.. .. ..Not printed.*

61 (7*d*). Return to an Order of the House of the 10th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Dr. Charles A. Webster, port physician at Yarmouth, County of Yarmouth N.S., and the same information regarding the appointment of Dr. Webster's successor. Presented 18th February, 1913.—*Mr. Law.. .. ..Not printed*

61 (7*e*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, papers, charges and correspondence between the Department of Marine and Fisheries and all other persons, regarding the dismissal of Jos. Lord, keeper of lighthouses at Pointe à la Mule on the River Richelieu, Parish of St. Blaise, County of Saint Jean and Iberville and of all reports thereon with reference to the dismissal of the said Mr. Lord. Presented 19th February, 1913.—*Mr. Demers.. .. .. ..Not printed.*

61 (7*f*). Return to an Order of the House of the 15th January, 1913, for a copy of all correspondence, letters, telegrams and petitions concerning the dismissal of Henri Friolet, wharfinger at Caraquet, and Richard Southwood, wharfinger and agent of the Storm Signal Service at Bathurst, Gloucester County, N.B., and the appointment of their successors. Presented 19th February, 1913.—*Mr. Turgeon.. .. .. ..Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (*7g*). Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, letters, telegrams, reports and other documents, respecting the removal of Joseph L. Robichaud, lighthouse keeper at Miscou, County of Gloucester and the appointment of his successor; also of all correspondence respecting the engagement of the engineer of fog alarm system attached to that station, and the certificates required by the Minister of Marine, showing the competence of that engineer; with the names of the new keeper and of the said engineer and their ages. Presented 19th February, 1913.—*Mr. Turgeon*.. .. ..*Not printed.*

61 (*7h*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Captain Pope as lighthouse keeper at Scatarie, Cape Breton South, N.S.. and of the evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same. Presented 19th February, 1913.—*Mr. Carroll*.. .. ..*Not printed*

61 (*7i*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Captain W. W. Lewis, as shipping master at Louisburg, Cape Breton South, Nova Scotia, and of evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same. Presented 19th February, 1913.—*Mr. Carroll.*
Not printed.

61 (*7j*). Return to an Order of the House of the 4th December, 1912, for a return showing the names of postmasters that have been dismissed in the County of Bonaventure since 1st October, 1911; the names of the postmasters who have been appointed to succeed them; the causes of the dismissals and a copy of all complaints and correspondence with respect to same, and of all reports of investigations where such have been held, with the reasons given for not holding any such investigation, when not held. Presented 19th February, 1913.—*Mr. Marcil*.. .. ..*Not printed*

61 (*7k*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of George Hines, lighthouse keeper at South Ingonish, riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same, and a detailed statement of the expenses of such investigation. Presented 20th February, 1913.—*Mr. McKenzie*..*Not printed.*

61 (*7l*). Return to an Order of the House of the 15th January, 1913, for a return showing a list of the lighthouse keepers removed by the present government in the County of Two Mountains, the names of such persons, the reasons for their dismissal, the nature of the complaints made against them; also a copy of all correspondence and petitions relating thereto, and reports of inquiries in the cases, where such have been held; and also the names of their successors. Presented 20th February, 1913.—*Mr. Ethier*.. .. ..*Not printed.*

61 (*7m*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Archibald McDonald, preventive officer at Mull River, Inverness County, Nova Scotia. Presented 20th February, 1913.—*Mr. Chisholm (Inverness)*..*Not printed.*

61 (*7n*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, correspondence on file referring to the dismissal of Donald Chisholm, of Tracadie, in the County of Antigonish, as preventive officer. Presented 20th February, 1913.—*Mr. Chisholm (Antigonish)*... .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (*7o*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, reports and other documents relative to the dismissal of Edward C. Humphreys, of Trenton, N.S., as an officer of the Inland Revenue Department and to the appointment of his successor. Presented 20th February, 1913.—*Mr. Macdonald.* *Not printed.*

61 (*7p*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of H. J. Fixott, port physician at Arichat, Richmond County, N.S. Presented 21st February, 1913.—*Mr. Kyte.. .. ..Not printed.*

61 (*7q*). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, letters, telegrams and other documents relating to the dismissal of D. Morin as postmaster of St. Pie de Bagot, County of Bagot. Presented 21st February, 1913.—*Mr. Mareil (Bagot).. .. ..Not printed.*

61 (*7r*). Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, investigations and papers generally concerning the dismissal of Ernest Paquin, postmaster of St. Cecile de Levrard, County of Nicolet. Presented 21st February, 1913.—*Mr. Lemieux.. .. ..Not printed.*

61 (*7s*). Return to an Address to His Royal Highness the Governor General of the 17th February, 1913, for a copy of all complaints and charges made against John R. McDonald, Indian agent at Heatherton, Antigonish County, of the recommendations t council and of the order in council made thereon, and of all letters, correspondence, and documents connected in any way with his dismissal. Presented 25th February, 1913.—*Mr. Chisholm (Antigonish)... .. ..Not printed.*

61 (*7t*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Joseph Day, customs officer at Little Bras D'Or, C.B., in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 25th February, 1913.—*Mr. McKenzie.. .. ..Not printed.*

61 (*7u*). Return to an Address to His Royal Highness the Governor General of the 29th January, 1913, for a copy of all complaints against Duncan McLeod, appraiser of customs at Sherbrooke, Province of Quebec, of all information obtained as to his conduct through seizures of goods by special officers of customs and by investigation; of all reports of investigation; of the order in council dismissing said Duncan McLeod; and of all correspondence between him and the Department of Customs. Presented 25th February, 1913.—*Mr. McCroe.. .. ..Not printed.*

61 (*7v*). Return to an Order of the House of the 17th February, 1913, for a copy of all papers, letters, telegrams, evidence, &c., given at the investigation or investigations and of reports of such investigations, relating to the dismissal of Edouard D Chiasson, sub-collector of customs at Lamèque, Gloucester County, and the appointment of his successor. Presented 25th February, 1913.—*Mr. Turgeon.. ..Not printed.*

61 (*7w*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of George F. Briggs, customs officer at McAdam Junction, York County, N.B. Presented 25th February, 1913.—*Mr. Carvell.. .. ..Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (7*x*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of William A. Duan, lightkeeper at Green Island, Richmond County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 25th February, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61 (7*y*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, charges, correspondence, letters, telegrams and other documents relating to the dismissal of Thomas Cameron, preventive officer at Andover, N.B., and of the evidence taken and reports of investigation held by Mr. E. T. C. Knowles, in connection with the same. Presented 26th February, 1913.—*Mr. Michaud*.. .. ..*Not printed.*

61 (7*z*). Return to an Order of the House of the 29th January, 1913, for a copy of all complaints and charges made against Joseph McDonald, late of the customs office at Sydney, Cape Breton, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal and the appointment of his successor. Presented 26th February, 1913.—*Mr. Carroll*.. .. ..*Not printed*

61 (8*a*). Return to an Order of the House of the 29th January, 1913, for a copy of all complaints and charges made against Angus McGillivray, late of customs office at Glace Bay, Cape Breton South, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal and the appointment of his successor. Presented 26th February, 1913.—*Mr. Carroll*.. .. ..*Not printed.*

61 (8*b*). Return to an Order of the House of the 3rd February, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Roderick Bain, boatman at New Campbellton, riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of the investigation held by H. P. Duchemin, in regard to same, with a detailed statement of expenses of such investigation. Presented 26th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (8*c*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of W. A. Scott, lockmaster at Cardinal, Ontario, and of the appointment of his successor. Presented 27th February, 1913.—*Mr. McMillan.* *Not printed.*

61 (8*d*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Bert Johnson, lockman at Nicholson, Ontario. Presented 27th February, 1913.—*Mr. Turgeon*.. .. ..*Not printed.*

61 (8*e*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of John Merrifield, lockmaster at Burritts Rapids, Ont., and the appointment of his successor. Presented 27th February, 1913.—*Mr. Chisholm.* *Not printed.*

61 (8*f*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Neil Cummings, lockmaster at Cardinal, Ontario, and of the appointment of his successor. Presented 27th February, 1913.—*Mr. McMillan*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (8*g*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, papers, charges and correspondence between the Department of Railways and Canals and all other persons, regarding the dismissal of Mr. François Chagnon, lockkeeper at Saint Jean, County of Saint Jean and Iberville, and of all reports thereon with reference to the dismissal of the said Mr. Chagnon. Presented 27th February, 1913.—*Mr. Demers*.. .. ..*Not printed.*

61 (8*h*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Neil McNeil, bridge tender, Intercolonial railway, at Grand Narrows in the riding of North Cape Breton and Victoria. Presented 27th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (8*i*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Archibald McKenzie, sectionman, Intercolonial railway, at Grand Narrows, in the riding of North Cape Breton and Victoria. Presented 27th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (8*j*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of John Fraser, bridge tender, Intercolonial railway, at Grand Narrows, in the riding of North Cape Breton and Victoria. Presented 27th February, 1913.—*Mr. McKenzie*.. .. ..*Not printed.*

61 (8*k*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Demetrius Crozier, lockman at Merrickville, Ontario. Presented 27th February, 1913.—*Mr. Proulx*.. .. ..*Not printed.*

61 (8*l*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Patrick Cussuk, lockman at Merrickville, Ontario Presented 27th February, 1913.—*Mr. Michaud*.. .. ..*Not printed.*

61 (8*m*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Joseph H. Webster, lockman at Nicholson, Ontario. Presented 27th February, 1913.—*Mr. Pacaud*.. .. ..*Not printed.*

61 (8*n*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Cyrus O'Neil, lockman at Nicholson, Ontario. Presented 27th February, 1913.—*Mr. Kyte*... .. ..*Not printed.*

61 (8*o*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Michael Laughtin, bridgeman at Burritts Rapids, Ontario. Presented 27th February, 1913.—*Mr. Papineau*.. .. ..*Not printed.*

61 (8*p*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of John McKay, bridgeman at Becketts, Ontario. Presented 27th February, 1913.—*Mr. Lanctot*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (8*q*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Edward Proctor, lockman at Burritts Rapids, Ont. Presented 27th February, 1913.—*Mr. Neely*.. .. ..*Not printed.*

61 (8*r*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of William Morrison, lockman at Burritts Rapids, Ont. Presented 27th February, 1913.—*Mr. Cash*.. .. ..*Not printed.*

61 (8*s*). Return to an Order of the House of the 15th January, 1913, for a copy of all letters, documents, telegrams, reports, correspondence and recommendations in any way relating to the dismissal of Adam Henderson, bridgemaster at Cardinal, Ontario. and of the appointment of his successor. Presented 27th February, 1913.—*Mr. Murphy.* *Not printed.*

61 (8*t*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of James Feehan, fishery guardian or warden at Tracadie Harbour and Savage Harbour, Prince Edward Island. Presented 27th February, 1913.—*Mr. Hughes (Kings, P.E.I.)*.. .. ..*Not printed*

61 (8*u*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of John C. McNeil, lighthouse keeper at Grand Narrows, in the riding of North Cape Breton and Victoria. Presented 27th February, 1913.—*Mr. McKenzie.* *Not printed.*

61 (8*v*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of A. A. Chisholm, fishery overseer at Margaree Forks, Inverness County, Nova Scotia. Presented 28th February, 1913.—*Mr. Chisholm (Inverness)*.. ..*Not printed.*

61 (8*w*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Charles E. Aucoin, collector of customs at Cheticamp, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish).* *Not printed.*

61 (8*x*). Return to an Order of the House of the 17th February, 1913, for a copy of all complaints and charges made against Charles L. Gass, late postmaster at Bayfield. Antigonish County, of the evidence taken, if any, before Commissioner Duchemin, and of his report thereon and of all letters, telegrams and documents of every kind relating to his dismissal and the appointment of his successor. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

61 (8*y*). Return to an Order of the House of the 17th February, 1913, for a copy of all letters and correspondence exchanged in reference to the dismissal of Cyprien Martin. of St. Basile, County of Madawaska, N.B., between the Department of Customs and the said Mr. Martin as preventive officer. Presented 28th February, 1913.—*Mr. Michaud*.. .. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (8*z*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against Angus A. Boyd, postmaster at Boyd's post office, Antigonish County, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal, and the appointment of a successor. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

61 (9*a*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against John B. Macdonald, postmaster at Glasburn, Antigonish County, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal, and the appointment of a successor. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed*

61 (9*b*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against Alex. G. Chisholm, postmaster at Ohio, Antigonish County, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal, and the appointment of a successor. Presented 28th February, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed*

61 (9*c*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against John J. McLean, postmaster at Cross Roads, Ohio, Antigonish County, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal and the appointment of a successor. Presented 28th February, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed*

61 (9*d*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against Dougald McDonald, postmaster at Doctors Brook, Antigonish County, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to his dismissal, and the appointment of his successor. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

61 (9*e*). Return to an Order of the House of the 9th December, 1912, for a copy of all complaints and charges made against Dan. A. McInnes, postmaster at Georgeville, Antigonish County, Nova Scotia, and of all letters, telegrams, and correspondence relating in any way to his dismissal, and the appointment of his successor. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*.. .. ..*Not printed.*

61 (9*f*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, letters, correspondence, telegrams and other documents relating to the dismissal of E. A. Asker, harbour master at Campbellton. Presented 3rd March, 1913.—*Mr. Reid (Restigouche)*.. .. ..*Not printed.*

61 (9*g*). Return to an Order of the House of the 10th February, 1913, for a copy of all papers, letters, documents and orders relative to the dismissal of Fred Shultz as caretaker of the armouries at Kentville, Nova Scotia, and of the appointment of William Shoop in his place and also for a statement of the stores in said armouries in the years 1910, 1911, 1912, respectively, and for a copy of all orders and regulations relative to the duties of such caretaker. Presented 3rd March, 1913.—*Mr. Macdonald.* *Not printed.*

61 (9*h*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Dr. Freeman O'Neil, from the Marine Hospital a Louisburg, Cape Breton South, N.S., and of evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same. Presented 10th March, 1913.—*Mr. Carroll*..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (9*i*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Leon N. Poirier, wharfinger at Descouse, Richmond County, N.S. Presented 10th March, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61 (9*j*). Return to an Order of the House of the 10th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Norman L. Trefry, shipping master at Yarmouth, County of Yarmouth. N.S., and the same information regarding the appointment of Mr. Trefry's successor Presented 10th March, 1913.—*Mr. Law*.. .. ..*Not printed.*

61 (9*k*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, documents, correspondence, &c., relating to the dismissal of James Amereault, lighthouse keeper at New Edinburgh, Digby County, N.S. Presented 10th March, 1913.—*Mr. McLean (Halifax)*.. .. ..*Not printed*

61 (9*l*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, evidence, reports, letters, correspondence, &c., relating to the dismissal of H. B. Manley, a clerk in the Dominion Lands Office at Saskatoon. Presented 10th March, 1913.—*Mr. McCraney*.. .. ..*Not printed.*

61 (9*m*). Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, letters, telegrams, papers and other documents in connection with the dismissal of John Spicer, senior assistant of the Moosejaw Land Agency. Presented 10th March, 1913.—*Mr. Knowles*.. .. ..*Not printed.*

61 (9*n*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, letters, telegrams and other documents respecting the dismissal of Robert Pragnall from the position of agent of the Dominion Land Office at Swift Current and the appointment of his successor. Presented 10th March, 1913.—*Mr. Knowles.*
Not printed.

61 (9*o*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, evidence, reports, letters, correspondence, &c., relating to the dismissal of G. M. Ullyot, a clerk in the Dominion Lands Office at Saskatoon. Presented 10th March, 1913.—*Mr. McCraney*.. .. ..*Not printed.*

61 (9*p*). Return to an Order of the House of the 9th December, 1912, for a return showing the detail and number of dismissals from public offices by the present government to this date in the riding of Saskatoon, with the names of the dismissed occupants, the reasons for their dismissals, the complaints against such officials, and all correspondence with respect to the same, and of all reports of investigations, in cases where such were held. Presented 17th March, 1913.—*Mr. McCraney*.. .. ..*Not printed*

61 (9*q*). Return to an Order of the House of the 17th February, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports, affidavits and other documents in the Department of Inland Revenue, respecting the dismissal of J. N. Poirier, Collector of Excise at Victoriaville, County of Arthabaska, and the names of the witnesses interested, with a copy of the evidence and a statement of expenses of the said inquiry. Presented 17th March, 1913.—*Mr. Brouillard*.. .. ..*Not printed.*

61 (9*r*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of John G. Morrison, fishery inspector at Englishtown, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 18th March, 1913.—*Mr. Kyte*.. .. ..*Not printed*

CONTENTS OF VOLUME 27—*Continued.*

61 (9*s*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Edward Landry, lightkeeper, Petite de Grat, Richmond County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 18th March, 1913.—*Mr. Kyte*.. .. ..*Not printed.*

61 (9*t*). Return to an Order of the House of the 27th January, 1913, for a copy of all documents, petitions, letters, correspondence, inquiries and reports concerning the dismissal of Evariste Talbot, employed in the general freight office of the Intercolonial. Presented 18th March, 1913.—*Mr. Lapointe (Kamouraska)*......*Not printed*

61 (9*u*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Railways or any department of the government, relating to the dismissal of Philip H. Ryan, an employee of the Intercolonial railway at Mulgrave, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 18th March, 1913.—*Mr. Sinclair*..*Not printed.*

61 (9*v*). Return to an Order of the House of the 3rd February, 1913, for a return showing how many postmasters and other post office employees were removed from office respectively, from the 1st of July, 1896, to the 1st of October, 1911, and the number in each province; and from the 10th of October, 1911, up to date, with the number in each province; also the number of post offices in operation in each province on the 1st July, 1896. Presented 26th March, 1913.—*Mr. Rainville*.............*Not printed.*

61 (9*w*). Return to an Address to His Royal Highness the Governor General of the 3rd February, 1913, for a copy of all orders in council, and of all letters, telegrams, complaints, petitions and of all other documents of any kind, in the possession of the government, or of any department or official thereof, in any way relating to or concerning the dismissal of Dr. Clarence T. Campbell, post office inspector at London, Ontario. Presented 26th March, 1913.—*Mr. Ross*.........................*Not printed.*

61 (9*x*). Return to an Order of the House of the 9th December, 1912, for a return showing the number of postmasters that have been dismissed in the County of Missisquoi since 1st October, 1911, the names of the postmasters who have been appointed to succeed them, the cause of the dismissals and a copy of all complaints and correspondence with respect to the same, and of all reports of investigations where such have been held. Presented 26th March, 1913.—*Mr. Kay*.............................*Not printed.*

61 (9*y*). Return to an Order of the House of the 27th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, regarding any change in any post office or postmastership in Bonaventure County, between 5th December, 1912, up to date. Presented 26th March, 1913.—*Mr. Marcil (Bonaventure)*......*Not printed.*

61 (9*z*). Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, documents, correspondence, orders in council, &c., relative to the dismissal of S. A. Johnson, late postmaster at Petite Rivière, Lunenburg County, N.S. Presented 26th March, 1913.—*Mr. MacLean (Halifax).*
Not printed.

CONTENTS OF VOLUME 27—*Continued.*

61 (10*a*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Murdock McKenzie, postmaster at Millville Boulardarie, Nova Scotia, in the riding of North Cape Breton and Victoria. Presented 26th March, 1913.—*Mr. McKenzie* .... *Not printed.*

61 (10*b*). Return to an Order of the House of the 9th December, 1912, for a copy of all documents, correspondence and telegrams relating to the dismissal of James Stewart, postmaster at Middleton, Antigonish County, and the appointment of his successor. Presented 26th March, 1913.—*Mr. Chisholm (Antigonish)*.................... *Not printed*

61 (10c). Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, telegrams and reports relating to the dismissal of Lauchlin McNeil. postmaster at New France, County of Antigonish, and the appointment of his suc- Presented 26th March, 1913. *Mr. Chisholm (Antigonish)*.................... *Not printed.*

61 (10*d*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Frank Dunlop, postmaster at Groves Point, Nova Scotia, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expense of such investigation. Presented 26th March, 1913.—*Mr. McKenzie.*
Not printed.

61 (10*e*). Return to an Order of the House of the 10th December, 1912, for a copy of all letters, telegrams, complaints, petitions and other documents relating to the investigation of A. W. Salsman, postmaster at Middle Country Harbour, N.S., and to the appointment of his successor. Presented 26th March, 1913.—*Mr. Sinclair.*
Not printed.

61 (10*f*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Richard Conroy, postmaster at Cross Roads, County Harbour, Guysborough County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 26th March, 1913.—*Mr. Sinclair*.................... *Not printed.*

61 (10*g*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Abner Carr, postmaster at St. Francis Harbour, Guysborough County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of expenses of such investigation. Presented 26th March, 1913.—*Mr. Sinclair*.................... *Not printed.*

61 (10*h*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Parker Sangster, postmaster, Upper New Harbour, Guysborough County, NS., and of all evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 26th March, 1913.—*Mr. Sinclair*.................... *Not printed.*

61 (10*i*). Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, orders in council and all other papers or documents in any way relating to the dismissal of Alexander Marion, from the position of postmaster at Rockland, Ontario. Presented 26th March, 1913.—*Mr. Murphy* .... *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (10*j*). Return to an Order of the House of the 4th December, 1912, for a copy of the evidence taken and the report made by each commissioner appointed since 1st of November, 1911, to conduct an investigation into charges of offensive partizanship made against postmasters in the County of Russell. Presented 26th March, 1913.—*Mr. Murphy* ....*Not printed.*

61 (10*k*). Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, evidence, reports, findings and correspondence, relating to the dismissal of Mathew Boutilier, recently postmaster at Mushaboom, Halifax County, N.S. Presented 26th March, 1913.—*Mr. MacLean (Halifax)*......................*Not printed*

61 (10*l*). Return to an Order of the House of the 29th January, 1913, for a return showing the names of the postmasters in the County of Joliette, who have been dismissed from 1896 to September, 1911; their respective parishes; dates of their dismissals; the reasons alleged; whether an inquiry was made in each case; on whose recommendation in each case the dismissals were made; names of successors in each case, and on whose recommendation were they appointed. Presented 26th March. 1913.—*Mr. Guilbault.*
Not printed.

61 (10*m*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, evidence, reports, letters, correspondence, &c., relating to the dismissal of T. Doane Crowell, postmaster at Shag Harbour, Shelburne County, N.S., and the appointment of his successor. Presented 26th March, 1913.—*Mr. Law.*
Not printed

61 (10*n*). Return to an Order of the House of the 22nd January, 1913, for a return showing the postmasters who have been dismissed in the County of Vaudreuil, the dates of their appointment, the cause of their dismissal and by whom their dismissal was requested. Presented 26th March, 1913.—*Mr. Boyer*........................*Not printed.*

61 (10*o*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, documents, letters, correspondence, &c., relating to the dismissal of Mrs. Spinney, postmistress at Upper Port La Tour, Shelburne County, N.S. Presented 26th March, 1913.—*Mr. Law*.................. ....*Not printed.*

61 (10*p*). Return to an Order of the House of the 29th January, 1913, for a return showing the number of postmasters dismissed in the County of Rimouski since 21st September, 1911, giving their names. Presented 26th March, 1913.—*Mr. Lapointe (Kamouraska)* ....*Not printed.*

61 (10*q*). Return to an Order of the House of the 4th December, 1912, for a return showing the detail and number of dismissals from public offices by the present government to this date in the riding of Wright, giving the names of the dismissed occupants, the reasons for their dismissal, the complaints against such officials, and a copy of all correspondence with respect to the same, with all reports of investigations where such were held. Presented 27th March, 1913.—*Mr. Devlin*......................*Not printed*

61 (10*r*). Return to an Order of the House of the 29th January. 9113, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John R. McLennan, janitor of the public building at Inverness Town, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 28th March, 1913.—*Mr. Chisholm (Inverness)*............. ....*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (10*s*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, and other documents relating to the dismissal of James Arbuckle, caretaker of the public buildings at Pictou, and the appointment of two successors in his stead. Presented 28th March, 1913.—*Mr. Macdonald*............................*Not printed.*

61 (10*t*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Mary Dunlop, telegraph operator at Groves Point, Cape Breton County, Nova Scotia, in the riding of North Cape Breton and Victoria. Presented 28th March, 1913.—*Mr. McKenzie* ....*Not printed.*

61 (10*u*). Return to an Order of the House of the 4th December, 1912, for a return showing the foremen employed at the various public works in the County of Gloucester on the 21st of September, 1911, who have been dismissed since by the present administration, containing their names, reasons of dismissal, nature of the charges made against them, also a copy of all correspondence connected with the same and reports of inquiries, in cases where such inquiries have been instituted. Presented 28th March, 1913.—*Mr. Turgeon*........................... ....*Not printed*

61 (10*v*). Return to an Order of the House of the 3rd February, 1913, for a copy of all letters, telegrams, papers and documents relative to the dismissal of Captain Lyons of the dredge *Northumberland*, and the appointment of his successor. Presented 28th March, 1913.—*Mr. Macdonald*................. ....*Not printed.*

61 (10*w*). Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all correspondence, orders in council and all other papers or documents in any way relating to the dismissal of James McCartin, from the position of inspector of the concrete work forming part of the contract for the construction of the The Plaza at the City of Ottawa Presented 28th March, 1913.—*Mr. Murphy* ...., ...*Not printed.*

61 (10*x*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Robert C. Morrison, postmaster at St. Peters, Richmond County, N.S., and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation, together with a copy of all recommendations, letters, telegrams and other papers relating t the appointment of Mr. Morrison's successor. Presented 31st March, 1913.—*Mr. Kyte.* *Not printed*

61 (10*y*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Richard Dugas, storm signal attendant at Alder Point, Nova Scotia, in the riding of North Capo Breton and Victoria. Presented 4th April, 1913.—*Mr. McKenzie.* *Not printed.*

61 (10*z*). Return to an Order of the House of the 20th January, 1913, for a return showing the names of all officials of the Marine and Fisheries Department who have been dismissed or removed in the County of Pictou, the reasons of the same, the evidence taken at any investigation held in regard to them, and the reports of said investigations, the names of their successors, and a copy of all letters, charges, complaints and recommendations from any person or persons in regard to the said removals or dismissals, or in regard to the appointment of their successors. Presented 4th April 1913.—*Mr. Macdonald*................... ....*Not printed*

CONTENTS OF VOLUME 27—*Continued.*

61 (11*a*). Return to an Order of the House of the 3rd March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of William L. Munro, lightkeeper at White Head, Guysborough County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 4th April, 1913.—*Mr. Sinclair*......................................*Not printed.*

61 (11*b*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, correspondence, reports and documents touching the dismissals of Alexander R. McAdam as fishery officer for the County of Antigonish, N.S., and the appointment of his successor. Presented 4th April, 1913.—*Mr. Chisholm (Antigonish). Not printed.*

61 (11*c*). Return to an Order of the House of the 19th February, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Marine and Fisheries Department, or any department of the government, relating to the dismissal of Stephen C. Richard, lightkeeper at Charlos Cove, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 4th April, 1913—*Mr. Sinclair*....................*Not printed.*

61 (11*d*). Supplementary to an Order of the House of the 7th February, 1912, for a return showing for each department of the government the names, post office addresses, offices, employment, and salaries of all persons employed either in the inside or outside service thereof, and of such persons not in the Civil Service, employed by the government in any department, on the tenth day of October, 1911, who have been removed from office or employment by dismissal; specifying in each case the manner of and grounds of such dismissals and the length of notice given to the persons removed, and also indicating in each case whether an inquiry was or was not held prior to such dismissal. Presented 7th April, 1913.—*Mr. Kyte*..............................*Not printed.*

61 (11e). Return to an Order of the House of the 7th December, 1912, for a return showing the public officers removed by the present government in the district of Lotbinière, with the names and duties of such persons, the reasons of their dismissal. the nature of the complaints made against them, also a copy of all correspondence relating thereto and reports of inquiries in the cases where such inquiries have been held. Presented 9th April, 1913.—*Mr. Fortier*..............................*Not printed*

61 (11*f*). Return to an Order of the House of the 29th January, 1913, for a copy of all complaints and charges made against Miss Gertie Lewis, as postmistress at Main-a dieu, Cape Breton South, N.S., and of all letters, telegrams and correspondence relating in any way to her dismissal and the appointment of a successor. Presented 9th April, 1913.—*Mr. Carroll* ....*Not printed.*

61 (11*g*). Return to an Order of the House of the 11th December, 1912, for a copy of all correspondence, letters, telegrams and other documents relating to the dismissal of John Taylor, late postmaster at Carnduff, Sask., and of all reports of investigation held, &c. Presented 9th April, 1913.—*Mr. Turriff*..........................*Not printed.*

61 (11*h*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Frederick Mitchell, from the position of postmaster at Dominion, Cape Breton South, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same. Presented 9th April, 1913.—*Mr. Carroll. Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (11*i*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers, letters, telegrams and other correspondence relating to the dismissal of Thomas J. Sears, postmaster at Lochaber, N.S., and the appointment of his successor; of the evidence taken, and of the report thereon made by Commissioner Duchemin, on the charges, if any, made against the dismissed postmaster. Presented 9th April, 1913.—*Mr. Chisholm* (*Antigonish*).. .. ..*Not printed.*

61 (11*j*). Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, letters, telegrams, papers and other documents in connection with the dismissal of the postmaster at Alsask, Saskatchewan. Presented 9th April, 1913.—*Mr. Knowles*.................... ....*Not printed*

61 (11*k*). Return to an Order of the House of the 3rd March, 1913, for a copy of all letters, telegrams, instructions and other papers and documents in the possession of the Department of Marine and Fisheries, or any officer thereof, relating to the dismissal or appointment of fishery guardians or fishery officers, in the County of Guysborough, N.S., bearing date since the 10th day of October, 1911. Presented 9th April, 1913.—*Mr. Sinclair*....................... ....*Not printed*

61 (11*l*). Return to an Order of the House of the 11th December, 1912, for a copy of all complaints and charges made against John R. Morrison, postmaster at Oban, Richmond County, N.S., and of all letters, telegrams and correspondence relating in any way to his dismissal, and the appointment of a successor. Presented 14th April, 1913.—*Mr. Kyte*................. ....*Not printed.*

61 (11*m*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of A. G. McDonald, postmaster of North East Margaree, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 14th April, 1913.—*Mr. Chisholm* (*Inverness*)..*Not printed.*

61 (11*n*). Return to an Order of the House of the 9th December, 1912, for a return showing in detail the number of dismissals from public office by the present government to this date, in the constituency of Qu'Appelle, with the names of the dismissed officers, and the reason for their dismissal, the complaints against such officials and a copy of all correspondence, petitions, papers and documents with respect to the same, and of all notes of evidence and reports of investigations in cases where they have taken place. Presented 14th April, 1913.—*Mr. Thomson* (*Qu'Appelle*)..........*Not printed*

61 (11*o*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Marine and Fisheries or any department of the government, relating to the dismissal of David Reid, fishery officer at Port Hilford, N.S., and if there was an investigation, the names of the witnesses examined, a copy of the evidence, and a detailed statement of the expenses of each investigation. Presented 15th April, 1913.—*Mr. Sinclair*..................................*Not printed.*

61 (11*p*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Robert Musgrave, postmaster at North Sydney, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 15th April, 1913.—*Mr. McKenzie*................*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (11*q*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of A. D. Archibald, postmaster at Glenelg, Guysborough County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 15th April, 1913.—*Mr. Chisholm* (*Inverness*)..............................*Not printed*

61 (11*r*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Leon N. Poirier, postmaster at Descouse, Richmond County, N.S., and of the evidence taken and of the reports of investigation held by H. P. Duchemin in regard to the same and a detailed statement of the expenss of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 15th April, 1913.—*Mr. Kyte*...*Not printed.*

61 (11*s*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Norman McAskill, postmaster at Framboise, Richmond County, N.S., and of the evidence taken and of the report of investigation held by H. P. Duchemin in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 15th April, 1913.—*Mr. Kyte*...*Not printed.*

61 (11*t*). Return to an Order of the House of the 11th December, 1912, for a copy of all papers, documents and correspondence relating to the dismissal of A. T. Doucet, postmaster and collector of customs at Salmon River, Digby County, N.S. Presented 15th April, 1913.—*Mr. Maclean* (*Halifax*).. .. ..*Not printed.*

61 (11*u*). Return to an Order of the House of the 29th January, 1913, for a copy of all complaints and charges made against Mrs. Annie Gallivan, as postmistress at Whitney Pier, Cape Breton South, Nova Scotia, and of all letters, telegrams and correspondence relating in any way to her dismissal and the appointment of a successor. Presented 15th April, 1913.—*Mr. Carroll*.....................................*Not printed.*

61 (11*v*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Wm. J. Paquet, postmaster at Souris, P.E.I. Presented 15th April, 1913.—*Mr. Hughes* (*Kings, P.E.I.*).. .. ..*Not printed.*

61 (11*w*). Return to an Order of the House of the 27th January, 1913, for a copy of all documents, correspondence, petitions and recommendations, &c., relating to the dismissal of the postmaster at St. Anaclet, County of Rimouski, during the year 1912, and of the appointment of his successor. Presented 15th April, 1913.—*Mr. Lapointe* (*Kamouraska*).. .. ..*Not printed*

61 (11*x*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of George Gunn, postmaster at French Village, Prince Edward Island. Presented 15th April, 1913.—*Mr. Hughes* (*Kings, P.E.I.*).. .. ..*Not printed.*

61 (11*y*). Return to an Order of the House of the 4th December, 1912, for a return showing the detail and number of dismissals from public offices by the present government to this date in the riding of Mackenzie, together with the names of the dismissed occupants, the reasons for their dismissal, the complaints against such officials, and a copy of all correspondence with respect to the same, and of all reports of investigations, where any such were held. Presented 15th April, 1913.—*Mr. Cash*..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (11*z*). Return to an Order of the House of the 7th April, 1913, for a copy of all charges investigated by Commissioner W. J. Code, and also of the evidence taken and the report made by the said commissioner. Presented 16th April, 1913.—*Mr. Murphy.* *Not printed.*

61 (12*a*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of D. F. McLean, fishery overseer at Port Hood, Inverness County, N.S., and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 16th April, 1913.—*Mr. Chisholm (Inverness)*........................*Not printed*

61 (12*b*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of J. Scott Nelson, postmaster at Louisdale, Richmond County, N.S., and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 16th April, 1913. —*Mr. Kyte*...................... ....*Not printed*

61 (12*c*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Joseph McMullen, from the post office at Bridgeport, Cape Breton South, Nova Scotia, and of evidence taken and reports of investigation held by H. P. Duchemin, in regard to the same. Presented 16th April, 1913.—*Mr. Carroll....Not printed.*

61 (12*d*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Frederick A. Martell, postmaster at L'Ardoise, Richmond County, N.S., and of the evidence taken and of the reports of investigation held by H. P. Duchemin, in regard to the same, and a detailed statement of the expenses of such investigation; and a copy of all papers relating to the appointment of his successor. Presented 16th April, 1913.—*Mr. Kyte*............................. ....*Not printed.*

61 (12*e*). Return to an Order of the House of the 11th December, 1912, for a copy of all representations, statements and complaints as to political activity made against John A. Macdonald, postmaster at McArras Brook, Antigonish County, and of all correspondence relating to the charges made against him and of the report of Commissioner Duchemin on said charges. Presented 16th April, 1913.—*Mr. Chisholm (Antigonish)*............... ....*Not printed*

61 (12*f*). Return to an Address to His Royal Highness the Governor General of the 7th December, 1911, for a copy of all papers, correspondence and orders in council in connection with and relating to the dismissal from office of public officials from each of the departments of government since the 1st day of October last past, including both Inside and Outside Service. Presented 18th April, 1913.—*Mr. Carvell......Not printed.*

61 (12*g*). Return to an Address to His Royal Highness the Governor General of the 3rd March, 1913, for a copy of all papers, documents, correspondence, evidence, order in council, &c., relative to the dismissal of Edward Doucett, sub-collector of customs. Digby County, N.S. Presented 21st April, 1913.—*Mr. McLean (Halifax).* *Not printed.*

61 (12*h*). Return to an Address to His Royal Highness the Governor General of the 3rd March, 1913, for a copy of all papers, documents, correspondence, evidence, orders in council, &c., relative to the dismissal of Mr. LeBlanc, sub-collector of customs, Church Point, Digby County, N.S. Presented 21st April, 1913.—*Mr. McLean (Halifax).* *Not printed*

CONTENTS OF VOLUME 27—*Continued.*

61 (12*i*). Return to an Order of the House of the 19th March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John C. Bourinot, chief customs officer at Port Hawkesbury, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 21st April, 1913.—*Mr. Chisholm (Inverness). Not printed.*

61 (12*j*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, evidence, correspondence, letters and telegrams in the Department of Railways and Canals since the 21st day of September, 1911, relating to the dismissal of Alexander E. Morrison, Point Tupper, N.S., from the service of the Intercolonial railway, and of all recommendations for the appointment of his successor. Presented 21st April. 1913.—*Mr. Kyte*.. .. ..*Not printed*

61 (12*k*). Return to an Order of the House of the 3rd February, 1913, for a copy of all letters, telegrams, reports and other papers and documents received from the officers of the Canadian Brotherhood of Railway Employees, by the Department of Labour. or of the Department of Railways and Canals, between the 1st day of January, 1912 and the 25th day of January, 1913, relating to investigations and dismissals of employees for political partizanship, and of the replies thereto. Presented 22nd April. 1913.—*Mr. Sinclair*..*Not printed.*

61 (12*l*). Return to an Order of the House of the 31st March, 1913, for a copy of all complaints and charges against James Falconer, of Newcastle, County of Northumberland. New Brunswick, as correspondent of the *Labour Gazette* at Newcastle, and of all letters, telegrams and other correspondence relating in any way to his dismissal and the appointment of a successor. Presented 22nd April, 1913.—*Mr. Loggie..Not printed.*

61 (12*m*). Return to an Order of the House of the 19th March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John B. Chisholm, lightkeeper at Port Hastings, Inverness County, Nova Scotia, and the evidence taken and report of investigation held by Mr. H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 24th April, 1913.—*Mr. Chisholm (Inverness)..........Not printed*

61 (12*n*). Return to an Order of the House of the 7th April, 1913, for a copy of all correspondence, telegrams, charges and other documents, relating to the dismissal of Epiphane Nadeau, immigration agent at St. Leonard, Victoria County, N.B. Presented 25th April, 1913.—*Mr. Michaud*.. .. ..*Not printed.*

61 (12*o*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of D. J. Morrison, boatman in the customs service at Big Bras D'or, North Cape Breton and Victoria, N.S., and of the evidence taken and of reports of the investigation held by H. P. Duchemin, in regard to the same, with a detailed statement of expenses of such investigation. Presented 25th April, 1913.—*Mr. McKenzie. Not printed*

61 (12*p*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams, and other documents relative to the dismissal of Rod McLeod, boatman in the customs service at Big Bras D'or, North Cape Breton and Victoria, N.S., and of the evidence taken and of reports of the investigation held by H. P. Duchemin, in regard to the same, with a detailed statement of expenses of such investigation. Presented 25th April, 1913.—*Mr. McKenzie. Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (12*q*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of D. McLachlin, postmaster at Marble Mountain, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 25th April, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed.*

61 (12*r*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Abram LeBlanc, postmaster at West Arichat, Richmond County, N.S., and of the evidence taken and reports of investigation held by H. P. Duchemin in regard to the same and a detailed statement of the expenses of such investigation, and a copy of all papers relating to the appointment of his successor. Presented 25th April, 1913.—*Mr. Kyte*............. ....*Not printed.*

61 (12*s*). Return to an Order of the House of the 11th December, 1912, for a copy of all correspondence, letters, telegrams and other documents relating to the dismissal of Charles J. Lafford, postmaster at Grand Grove, Richmond County, N.S., and of all evidence taken and report of investigation held by H. P. Duchemin in regard to the same; also a detailed statement of the expenses of such investigation. Presented 25th April, 1913.—*Mr. Kyte*...................... ....*Not printed*

61 (12*t*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of W. S. Lawrence, postmaster at Margrave Harbour, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin. in regard to the same; also a detailed statement of the expenses of such investigation. Presented 25th April, 1913.—*Mr Chisholm (Inverness)*.. .. ..*Not printed.*

61 (12*u*). Return to an Order of the House of the 11th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John K. McDonald, postmaster at Whycocomagh, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 25th April, 1913.—*Mr. Chisholm (Inverness)*......................*Not printed*

61 (12*v*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Captain P. J. Wilcox, from the customs office at Louisburg, Cape Breton South, Nova Scotia, and of evidence taken and reports of investigations held by H. P Duchemin, in regard to the same. Presented 29th April, 1913.—*Mr. Carroll.*
Not printed

61 (12*w*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of M. J. McKennon, from the customs office at Glace Bay, Cape Breton South, Nova Scotia, and of evidence taken and reports of. investigation held by H. P. Duchemin, in regard to the same. Presented 29th April, 1913.—*Mr. Carvell*......*Not printed*

61 (12*x*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Captain John Arsenault, telegraph line repairer at Alder Point, Cape Breton, in the riding of North Cape Breton and Victoria, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to same, and a detailed statement of the expenses of such investigation. Presented 29th April, 1913.—*Mr. McKenzie.*
Not printed.

CONTENTS OF VOLUME 27—*Continued.*

61 (12*y*). Return to an Order of the House of the 9th December, 1912, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Mrs. John Arsenault, telegraph operator at Alder Point, N.S., in the riding of North Cape Breton and Victoria. Presented 2nd May, 1913.—*Mr. McKenzie.* *Not printed*

61 (12*z*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Railways and Canals or any department of the government, relating to the dismissal of A. J. Wilkinson, at Mulgrave, N.S and if there was an investigation, the names of all witnesses examined and a detailed statement of the expenses of such investigation. Presented 2nd May, 1913.—*Mr. Sinclair*..*Not printed.*

61 (13*a*). Charges made against Mr. H. A. Bayfield, superintendent of dredging, British Columbia.—(*Senate*).. .. ..*Not printed.*

61 (13*b*). Return to an Order of the House of the 31st March, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of H. G. McKay, lighthouse keeper at Bird Island, Big Bras D'or, North Cape Breton and Victoria, and of the evidence taken, and of reports of the investigation held by H. P. Duchemin, in regard to the same, with a detailed statement of expenses of such investigation. Presented 5th May, 1913.—*Mr. McKenzie*..........*Not printed.*

61 (13*c*). Return to an Order of the House of the 10th March, 1913, for a copy of all reports, charges, and correspondence in the office of the Department of Marine and Fisheries relating to charges of political partizanship against Michael O'Brien, lightkeeper at Bear Island, Richmond County, N.S., and of the instructions issued to H. P. Duchemin, commissioner, to investigate the same together with the Commissioner's report and finding thereon, and his expenses of holding such investigations. Presented 7th May, 1913.—*Mr. Kyte*..*Not printed.*

61 (13*d*). Return to an Order of the House of the 17th February, 1913, for a copy of all correspondence, letters, telegrams, reports, recommendations and other documents bearing on or having relation to the dismissal of J. H. Leduc, as medical port officer of the port of Three Rivers, P.Q. Presented 7th May, 1913.—*Mr. Bureau..Not printed.*

61 (13*e*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Patrick Shea, postmaster at Tompkinsville, Guysborough County, N.S. Presented 7th May, 1913.—*Mr. Sinclair*..*Not printed.*

61 (13*f*). Return to an Order of the House of the 29th January, 1913, for a copy of all complaints and charges made against Elias Rawding, postmaster at Clementsport, Annapolis County, N.S., and of all letters, petitions, telegrams, and other correspondence relating in any way to his dismissal and the appointment of a successor. Presented 7th May, 1913.—*Mr. Sinclair*..*Not printed.*

61 (13*g*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Charles McLean, postmaster at Strathlorne, Inverness County, Nova Scotia Presented 7th May, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed.*

61 (13*h*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Angus R. McDonald, postmaster at Broad Cove Chapel, Inverness County, Nova Scotia. Presented 7th May, 1913.—*Mr. Chisholm (Inverness)*.. ..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (13*i*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of John McPhail, postmaster at Scotsville, Inverness County, Nova Scotia. Presented 7th May, 1913.—*Mr. Chisholm (Inverness)*....................*Not printed.*

61 (13*j*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, complaints, petitions or other documents of any kind received by the government, or any member or official thereof, relating to the conduct of J. Morgan, one time postmaster of the village of Ailsa Craig, Ontario, as such, and relating to an investigation into said conduct. Presented 7th May, 1913.—*Mr. Ross.* *Not printed*

61 (13*k*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Roderick McLean, postmaster at Kenlock, Inverness County, Nova Scotia. Presented 8th May, 1913.—*Mr. Chisholm (Inverness)*......................*Not printed*

61 (13*l*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Allan Gillis, postmaster at Gillisdale, South West Margaree, Inverness County, Nova Scotia. Presented 8th May, 1913.—*Mr. Chisholm (Inverness).* *Not printed.*

61 (13*m*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of David Shaw, postmaster at Marsh Brook, North East Margaree, Inverness County, Nova Scotia. Presented 8th May, 1913.—*Mr. Chisholm (Inverness).* *Not printed*

61 (13*n*). Return to an Order of the House of the 29th January, 1913, for a copy of all papers concerning the investigation and dismissal of Helen Joubert, postmistress at Sayabec, Quebec. Presented 8th May, 1913.—*Mr. Lemieux*................*Not printed.*

61 (13o). Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, letters, and telegrams between the Honourable Postmaster General or the Post Office Department, and any person or persons, relative to the dismissal or the request therefor of D. A. Redmond, until recently postmaster at Brinston, Ontario. Presented 8th May, 1913.—*Mr. Graham*..................................*Not printed.*

61 (13*p*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Dan. McEachern, postmaster at McEachern's Mills, Broad Cove Chapel, Inverness County, Nova Scotia. Presented 8th May, 1913.—*Mr. Chisholm (Inverness).* *Not printed.*

61 (13*q*). Return to an Order of the House of the 3rd February, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Daniel Dunlop, postmaster at New Campbellton, riding of North Cape Breton and Victoria, N.S., and of the evidence taken and reports of the investigation held by H. P. Duchemin, in regard to same, with a detailed statement of expense of such investigation. Presented 8th May, 1913.—*Mr. McKenzie*.............*Not printed.*

61 (13*r*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Arthur Armstrong, postmaster at Greenfield, Carleton County, N.B. Presented 8th May, 1913.—*Mr. Carvell*.............................. ....*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (13*s*). Return to an Order of the House of the 3rd February, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relative to the dismissal of Alex. Matheson, postmaster at Boulardarie Centre, north riding Cape Breton and Victoria. Presented 8th May, 1913.—*Mr. McKenzie*............*Not printed.*

61 (13*t*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Arthur Talbot, late postmaster at Robertsville, County of Megantic, Province of Quebec. Presented 8th May, 1913.—*Mr. Pacaud*....................*Not printed.*

61 (13*u*). Dismissal of N. C. Lyster, late postmaster at Lloydminster, Sask.—(*Senate*). *Not printed.*

61 (13*v*). Return to an Order of the House of the 2nd April, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of Mrs. Maggie Cameron, postmistress at Achosnach, Inverness County, Nova Scotia. Presented 9th May, 1913.—*Mr. Chisholm (Inverness)*.. .. .. ..*Not printed.*

61 (13*w*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of David Fraser, postmaster at North East Margaree, Inverness County, Nova Scotia. Presented 9th May, 1913.—*Mr. Chisholm (Inverness)*.. .. .. ..*Not printed.*

61 (13*x*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal and retention of W. Stayley Porter, postmaster, Port Maitland, Yarmouth County, N.S., and of the evidence taken and report of investigation held by Charles Lane, in regard to the same; also a detailed statement of expenses of such investigation. Presented 9th May, 1913.—*Mr. Law*................................*Not printed*

61 (13*y*). Return to an Order of the House of the 29th January, 1913, for a copy of all charges, telegrams and other documents relating to the dismissal of Alex. McQueen, postmaster at Kowstoke, Inverness County, Nova Scotia, and of the evidence taken and report of investigation held by H. P. Duchemin, in regard to the same; also a detailed statement of the expenses of such investigation. Presented 9th May, 1913.—*Mr. Chisholm (Inverness)* .. ..*Not printed.*

61 (13*z*). Return to an Order of the House of the 3rd February, 1913, for a return showing the number of employees of the Department of Public Works who have been dismissed in the County of Berthier since the 21st September, 1911, giving the names of the said employees; if an inquiry was held in each case; on whose recommendation, in each case, these dismissals were made; the names of those appointed successors to these persons and on whose recommendation. Presented 12th May, 1913.—*Mr. Beland* *Not printed.*

61 (14*a*). Return to an Order of the House of the 10th February, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents in connection with the dismissal and retention of Jesse L. Morton, postmaster at Lower Argyle, N.S., and of the evidence taken and report of the investigation held by Mr. Lane, in regard to the same, also a detailed statement of the expenses of such investigation. Presented 20th May, 1913.—*Mr. Law*..*Not printed*

61 (14*b*). Return to an Order of the House of the 10th February, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents in connection with the dismissal of Mrs. M. C. Gaudet, postmistress at West Pubnico, Yarmouth County, N.S., and of the evidence taken and report of the investigation held by Mr. Lane, in regard to same, and also a detailed statement of the expenses of such investigation Presented 20th May, 1913.—*Mr. Law*..*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (14*c*). Return to an Order of the House of the 28th April, 1913, for a copy of all charges, correspondence, telegrams, and other documents relative to the dismissal of John P. McKinnon, section foreman on the Intercolonial railway at Shubenacadie, in the riding of North Cape Breton and Victoria, N.S. Presented 20th May, 1913.—*Mr. McKenzie*.................. ....*Not printed.*

61 (14*d*). Return to an Order of the House of the 15th January, 1913, for a copy o all papers, letters, telegrams, evidence and other documents regarding the dismissal of Mary A. Bohan, as postmistress at Bath, Carleton County, N.B. Presented 21st May, 1913.—*Mr. Carvell*................................ ....*Not printed.*

61 (14*e*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Edward Lafferty, postmaster at Benton, Carleton County, N.B. Presented 21st May, 1913.—*Mr. Carvell* ....*Not printed.*

61 (14*f*). Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, telegrams, evidence and other documents regarding the dismissal of Dennis McGaffigan, postmaster at Florenceville, Carleton County, N.B. Presented 21st May, 1913.—*Mr. Carvell*.................. ....*Not printed.*

61 (14*g*). Return to an Order of the House of the 27th January, 1913, for a copy of all correspondence and documents bearing upon any change made or asked for in the employees of the Department of Marine and Fisheries in the County of Bonaventure between 5th December, 1912, up to date. Presented 27th May, 1913.—*Mr. Marcil (Bonaventure)*.. .. ..*Not printed.*

61 (14*h*). Return to an Order of the House of the 15th January, 1913, for a copy of all charges, correspondence, letters, telegrams and other documents relating to the dismissal of J. A. McKenzie, postmaster at Ashfield, Inverness County, N.S. Presented 2nd June, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed.*

61 (14*i*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, reports and other papers and documents in the possession of the Post Office Department, or any department of the government, relating to the dismissal of James Bowles, postmaster at Alder River, N.S., and if there was an investigation, the names of all the witnesses examined, a copy of the evidence, and a detailed statement of the expense of such investigation. Presented 2nd June, 1913.—*Mr. Sinclair*..................... ....*Not printed.*

61 (14*j*). Return to an Order of the House of the 21st April, 1913, for a copy of all correspondence, complaints, reports, recommendations, petitions, certificates and other documents relating to the dismissal of Mr. Edmund Lacroix, as postmaster of the Parish of St. Joseph du Lac, County of Two Mountains, and the appointment of Rodrique Larocque, of the same place as postmaster. Presented 2nd June, 1913.—*Mr. Ethier*....................... ....*Not printed*

61 (14*k*). Return to an Order of the House of the 26th May, 1913, for a copy of all papers, letters, documents, reports and inquiry, relating to the lighthouse keeper of the Parish of Repentigny, County of L'Assomption. Presented 3rd June, 1913.—Mr. *Seguin*...................... ....*Not printed.*

61 (14*l*). Return to an Order of the House of the 16th April, 1913, for a copy of all papers, documents, evidence, reports, &c., relating to the dismissal of B. C. Kanock, late shipping master at Lunenburg, N.S. Presented 4th June, 1913.—*Mr. McLean (Halifax).* *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

61 (14*m*). Return to an Order of the House of the 3rd March, 1913, for a copy of all complaints, accusations, correspondence, petitions and telegrams, respecting the dismissal of Ulric Thibaudeau, agent for pilots at Quebec, and of all documents respecting the appointment of his successor, such as petitions, letters of recommendation, &c., and of the evidence and report made after the inquiry held by the inquiring commissioner; and also a detailed statement of the expenses caused by this inquiry. Presented 4th June, 1913.—*Mr. Delisle*......................................*Not printed.*

61 (14*n*). Supplementary return to an Order of the House of the 20th January, 1913, for a return showing the names of all officials of the Marine and Fisheries Department who have been dismissed or removed in the County of Pictou, the reasons of the same, the evidence taken at any investigation held in regard to them, and the reports of said investigations, the names of their successors, and a copy of all letters, charges, complaints and recommendations from any person or persons in regard to the said removals or dismissals, or in regard to the appointment of their successors. Presented 4th June, 1913.—*Mr. Macdonald*..*Not printed.*

61 (14*o*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, or any department of the government relating to the dismissal of Captain Freeman Myers, postmaster at Cole Harbour, Guysborough County, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 4th June, 1913.—*Mr. Sinclair.* *Not printed*

61 (14*p*). Return to an Order of the House of the 4th December, 1912, for a return showing all public officers removed by the present government in the district of St. James, Montreal, together with the names and duties of such persons, the reasons of their dismissal, the nature of the complaints brought against them, and a copy of all correspondence relating thereto, and of reports of inquiries in the cases where such have been held. Presented 4th June, 1913.—*Mr. Lapointe (Montreal)*..........*Not printed*

61 (14*q*). Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a return showing all the employees of the Dominion government in the constituency of Edmonton, dismissed between 10th of October, 1911, and 21st of November, 1912, the salary being paid to such employee at the time of his dismissal, together with a copy of all correspondence, recommendations to council, orders in council, and all other papers or documents in any way connected with such dismissals. Presented 4th June, 1913.—*Mr. Oliver*..*Not printed.*

61 (14*r*). Return to an Order of the House of the 4th December, 1912, for a return showing the names of all officials in the district of Sunbury and Queens, who have been dismissed or removed from office since September, 1911, the reason for such dismissal or removal, the evidence taken at any investigation held in regard to them, the reports upon such investigations, the name of any successor appointed in place of dismissed officials, and a copy of all letters, charges, complaints and recommendations in regard to the said removals or dismissals, or in regard to the appointment of their successors. Presented 4th June, 1913.—*Mr. McLean (Sunbury)*...........*Not printed.*

61 (14*s*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Marine and Fisheries, or any department of the government relating to the dismissal of Levi Munroe, harbour master at

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White Head, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 4th June, 1913.—*Mr. Sinclair*....................*Not printed.*

61 (14*t*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, or any department of the government, relating to the dismissal of Stanford Langley, postmaster at Isaac Harbour North, N.S., and if there was an investigation the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 5th June, 1913.—*Mr. Sinclair*..................................*Not printed.*

61 (14*u*). Return to an Order of the House of the 24th February, 1913, for a copy of all letters, telegrams, correspondence, charges, evidence, reports, and other documents relating to the dismissal of Hugh R. McAdam as postmaster at Arisaig, N.S., and the appointment of Reverend Daniel L. Macdonald as his successor. Presented 5th June, 1913.—*Mr. Chisholm (Antigonish)*...................... ....*Not printed.*

61 (14*v*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Post Office Department, or any department of the government, relating to the proposed dismissal of J. J. McNeil, at Grant's Lake, N.S., and if there was an investigation, the names of the witnesses examined and a detailed statement of the expenses of such investigation. Presented 5th June, 1913.—*Mr. Sinclair*...................... ....*Not printed*

61 (14*w*). Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, evidence, reports and other papers and documents in the possession of the Department of Railways and Canals, or any department of the government, relating to the dismissal of Alex. McInnis, car inspector of the Intercolonial railway at Mulgrave, N.S., and if there was an investigation, the names of all witnesses examined, a copy of the evidence, and a detailed statement of the expenses of such investigation. Presented 6th June, 1913.—*Mr. Sinclair..Not printed.*

61 (14*x*). Return to an Order of the House of the 28th April, 1913, for a copy of all charges, correspondence, telegrams, and other documents relative to the dismissal of Archibald McDonald, bridge tender on the Intercolonial railway at Grand Narrows, Iona, riding of North Cape Breton and Victoria, N.S. Presented 6th June, 1913.—*Mr. McKenzie*............................ ....*Not printed.*

61 (14*y*). Names of all officials dismissed in Shelburne and Queens from 1st December, 1896.—*(Senate)*.................... ....*Not printed.*

62. Return to an Order of the House of the 4th December, 1912, for a return showing the number of all contracts cancelled in the County of Bonaventure since the 1st of October, 1911; the names of the contractors, the prices paid to them, the reasons for the cancellation in each case; and a copy of any investigations and reports had into the causes of such cancellations, the names of the new contractors and the prices paid to them in each case. Presented 14th January, 1913.—*Mr. Marcil (Bonaventure).* *Not printed.*

62*a*. Return to an Order of the House of the 5th December, 1912, for a return showing the number of rural mail delivery routes that have been established in Canada since the 1st January, 1912, in each province and county, respectively. Presented 14th January, 1913.—*Mr. Lemieux* ....*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

62*b*. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, letters, telegrams, complaints and other documents relating to the cancelling of the contract for conveying His Majesty's mails, entered into on the 1st day of January, 1912, between the Honourable Postmaster General and Mr. J. C. Beeman, of Guthrie, County of Missisquoi; together with the reason for the cancellation of this contract, the price paid to Mr. Beeman, the name of the present contractor and the price paid to him. Presented by Hon. Mr. Pelletier.—*Mr. Kay*........*Not printed.*

62*c*. Return to an Order of the House of the 11th March, 1912, for a copy of all letters, requests, memorandums, tenders and other documents in the possession of the Post Office Department relating to the calling for tenders and the granting of the contract now in force for the carrying of the mail between Sorel and Ste. Victoire, County of Richelieu. Presented 20th January, 1913.—*Mr. Cardin*....................*Not printed.*

62*d*. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, letters, telegrams, tenders, bonds, agreements, contracts and other documents in the possession of the Post Office Department relating to the letting of the contract for carrying the mails between Heatherton and Guysborough, in the year 1912; and also relating to any temporary agreement entered into prior to the date of letting such contract. Presented 21st January, 1913.—*Mr. Sinclair*................*Not printed*

62*e*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters and other documents relating to the establishment of a rural mail service between Saltsprings and West River Station, in the County of Pictou, in the year 1912. Presented 17th February, 1913.—*Mr. Macdonald*................................*Not printed.*

62*f*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, and other documents relating to the establishment of a rural mail delivery service between Merigonish Station, County of Pictou, and Arisaig, in the County of Antigonish, in the year 1912. Presented 17th February, 1913.—*Mr. Macdonald.*
Not printed

62*g*. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, letters, telegrams and reports regarding the termination of H. D. Decoste's contract for carrying the mails between Linwood Station and Linwood post office and the making of a new contract with D. Delorey, from the 1st January, 1913. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*..........................*Not printed.*

62*h*. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, complaints, recommendations, telegrams and reports bearing on the railway mail service in Bonaventure County from October, 1911, up to date, and on the appointment and dismissal of officers in such connection, with the names, residences, salaries and duties, as well as of all documents bearing on the suspension of the railway mail service during the period mentioned, as well as a copy of all documents referring to agreements made to meet such a contingency during the coming winter. Presented 25th March, 1913.—*Mr. Marcil (Bonaventure)*....................*Not printed.*

62*i*. Return to an Order of the House of the 9th December, 1912, for a copy of all tenders received and the contracts entered into for the carrying of the mails between St. Andrew and Beauley, County of Antigonish, and of all letters, telegrams and correspondence on file in the Post Office Department containing any recommendation or advice regarding the awarding of such contract, or in any way referring thereto. Presented 26th March, 1913.—*Mr. Chisholm (Antigonish)*......................*Not printed.*

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62*j*. Return to an Order of the House of the 3rd February, 1913, for a return showing what changes, if any, have been made in the contracts for the carrying of the mails in the County of Berthier, since the 21st September, 1911; in what parishes, on what date, and for what reason; to whom have the new contracts been granted, and if a tender was asked for in each case. Presented 14th April, 1913.—*Mr. Béland.* *Not printed*

62*k*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, bonds, reports and other papers and documents in the possession of the Post Office Department, or any department of the government, relating to the letting of the mail contract between Guysborough and Charlos Cove, County of Guysborough, N.S., during the year 1912. Presented 28th April, 1913.—*Mr. Sinclair.* *Not printed.*

62*l*. Return to an Order of the House of the 14th April, 1913, showing the names of the various railway mail clerks employed, respectively, on the Montreal and Quebec divisions and the date of the appointment and residence of each. Presented 7th May, 1913.—*Mr. Bureau* ....*Not printed.*

62*m*. Return to an Order of the House of the 9th April, 1913, for a copy of the contract entered into by the Post Office Department with the Ontario Equipment Company of Ottawa relating to the purchase of locks for mail bags. Presented 7th May, 1913.—*Mr. Carrell* ....*Not printed.*

62*n*. Return to an Order of the House of the 7th April, 1913, for a copy of all correspondence, telegrams, &c., exchanged between the Honourable the Postmaster General and Dr. Faucher, of Quebec, concerning the purchase of a certain patented lock for mail bags. Presented 7th May, 1913.—*Mr. Lapointe* (*Kamouraska*).. .. .. ..*Not printed.*

62*o*. Return to an Order of the House of the 7th April, 1913, for a copy of all correspondence, telegrams, &c., exchanged between the Honourable the Postmaster General and Mr. Aimé Dion, advocate of Quebec, concerning the purchase of a certain patented lock for mail bags. Presented 7th May, 1913.—*Mr. Verville*................*Not printed.*

62*p*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, petitions, telegrams, complaints, reports, bonds of indemnity, and all other papers and documents in the possession of the Post Office Department, or any department of the government, relating to the contract for carrying the mails between Linwood or some point of the Intercolonial railway, County of Antigonish, N.S., and Grosvenor, County of Guysborough, N.S. Presented 9th May, 1913.—*Mr. Sinclair*....*Not printed.*

62*q*. Return to an Order of the House of the 24th April, 1913, for a return showing the full names of the mail carriers in the County of Vaudreuil and Soulanges; between what place they perform the service; the distance between each of these places; the amount of each carrier's contract, and the amount the government paid for the carriage of the mail in these different places before September, 1911. Presented 16th May, 1913.—*Mr. Boyer*..*Not printed.*

62*r*. Return to an Order of the House of the 7th May, 1913, for a return showing the number of post offices in Yarmouth County, Nova Scotia, not served with daily mail, giving the names and the number of times per week served. Presented 20th May, 1913. —*Mr. Law*........................ .... *Not printed.*

62*s*. Return to an Address to His Excellency the Administrator of the 7th April, 1913, for a copy of all orders in council, reports of experts and contracts, in connection with

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the different purchases of rural mail delivery boxes made by the Post Office Department since 1908, until 1st January, 1912. Presented 21st May, 1913.—*Mr. Lemieux.* *Not printed.*

62*t*. Return to an Order of the House of the 12th May, 1913, for a return giving the names of the post offices and of the postmasters in the Counties of Soulanges and Vaudreuil. Presented 21st May, 1913.—*Mr. Boyer*........................*Not printed.*

62*u*. Return to an Order of the House of the 5th December, 1912, for a copy of all letters, telegrams, petitions and other documents relating to the establishment of rural mail delivery routes in the County of Pictou since the 1st October, 1911, with a statement of all routes applied for, of routes established and of those refused, and the reason for their refusal. Presented 2nd June, 1913.—*Mr. Macdonald*.............*Not printed.*

62*v*. Return to an Order of the House of the 31st March, 1913, for a copy of all correspondence concerning the purchase of new locks for mail bags by the Post Office Department from the Ontario Equipment Company. Presented 4th June, 1913.—*Mr. Carrell.* *Not printed.*

62*w*. Return to an Order of the House of the 17th February, 1913, for a copy of all correspondence, letters, telegrams, memoranda, tenders, bonds and all other documents relative to the contract for the carrying of the mail between the post office and Canadian Pacific Railway station at Three Rivers and vice versa, since the eleventh day of October, 1911, to date. Presented 4th June, 1913.—*Mr. Tobin*..........*Not printed.*

62*x*. Return to an Order of the House of the 21st April, 1913, for a copy of all correspondence, telegrams, complaints, affidavits, reports, recommendations, requests, certificates, contracts and other documents relating to the cancelled contract of M. E. Bougie, for carrying the mails between the post office and railway station at Bromptonville, Quebec. Presented 4th June, 1913.—*Mr. Bureau*..............................*Not printed.*

63. Return to an Order of the House of the 4th December, 1912, for a return showing all the new post offices opened in the County of Bonaventure, since October, 1911, up to date, and a copy of the correspondence in connection therewith, together with the names of such post offices and postmasters, and the location of such offices; and also a copy of all papers asking for such offices. Presented 14th January, 1913.—*Mr. Marcil (Bonaventure)*..................... ....*Not printed*

64. Return to an Order of the House of the 9th December, 1912, for a copy of all petitions, correspondence, memoranda, recommendations and other papers or documents in the possession of the Department of Marine and Fisheries relating to the proposals to supply medicine or medical attendance free, or otherwise, to Canadian boat fishermen. Presented 14th January, 1913.—*Mr. Sinclair*..........................*Not printed*

65. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, petitions, complaints, memoranda, reports and investigations regarding the service performed by the steamer *Canada*, owned by the Inter-Provincial Navigation Company of Fraserville, Quebec, since October, 1911, up to date, and also of all documents bearing on the present contract with the Department of Trade and Commerce, or the renewal or extension thereof. Presented 14th January, 1913.—*Mr. Marcil (Bonaventure)*............... ....*Not printed*

66. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, telegrams, letters, &c., relating to the matter of the establishment of a lobster hatchery at Spry Bay, Halifax County, N.S. Presented 14th January, 1913. —*Mr. Maclean (Halifax)*.......................... ....*Not printed.*

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67. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, telegrams, &c., between the Department of Trade and Commerce and any company, person or persons, relative to the continuance and payment of a subsidy towards a steamship service between St. John, N.B., and Bear River, N.S., for the fiscal year 1912, and performed during the fiscal year 1911. Presented 17th January 1913.—*Mr. Maclean (Halifax)*...*Not printed.*

67*a*. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, documents, memoranda, letters, telegrams and documents bearing on a request for a subsidy for a steam service between Bonaventure, Quebec, or any other part of Bonaventure County and Bathurst, New Brunswick, or any other part of Gloucester County, New Brunswick, and between New Richmond, Quebec, and Dalhousie, New Brunswick, and between Carleton and Miguasha, Quebec, and Dalhousie, New Brunswick, or Campbellton, New Brunswick, or both, as well as a copy of all replies made for such subsidies and this since October, 1911, to date. Presented 14th January. 1913.—*Mr. Marcil (Bonaventure)*..*Not printed.*

67*b*. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all advertisements, tenders, contracts, orders in council memoranda, papers, letters and correspondence in any way relating to a subsidized steamship service between Canadian ports and any ports of the British West Indies, or any proposed improvement or extension of such steamship service since 1st November, 1911 to the present time. Presented 15th January, 1913............*Not printed.*

67*c*. Return to an Order of the House of the 4th December, 1912, for a copy of all reports made by officials of the Department of Railways and Canals on the Quebec and Oriental railway, and the Atlantic, Quebec and Western railways, together with a statement of the subsidies paid such railways since October, 1911, up to date, and a copy of all correspondence in that connection. Presented 17th January, 1913.—*Mr Marcil (Bonaventure)*..*Not printed*

67*d*. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence between the Minister of Railways or any other member of the government and any person regarding the acquisition by the government of Canada of the Quebec Oriental railway, formerly the Atlantic and Lake Superior railway, and the Atlantic, Quebec and Western railway, or both. Presented 27th January, 1913.—*Mr. Marcil (Bonaventure)*..*Not printed.*

67*e*. Return to an Order of the House of the 29th January, 1913, for a copy of the report made to the Minister of Railways and Canals by the party of government engineers who inspected the Quebec and Saguenay railway during December, 1912, January, 1913. Presented 27th February, 1913.—*Mr. Lemieux*........................*Not printed.*

67*f*. Return to an Order of the House of the 17th February, 1913, for a copy of all reports made by any engineers or accountants to the Minister of Railways and Canals on the usefulness of the Atlantic, Quebec and Western railway and the Quebec Oriental railway, to the Intercolonial railway as branch lines or feeders. Presented 27th February, 1913.—*Mr. Marcil (Bonaventure)*..............................*Not printed.*

67*g*. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, documents, petitions, orders in Council, memoranda, correspondence, &c., by and between the government of Canada or any member thereof, and the government of the province of British Columbia, or any member thereof, since 1st May, 1912, relating to the subject to an increase of the provincial subsidy to the said province. Presented 16th April, 1913.—*Mr. Maclean (Halifax).*
Printed for sessional papers.

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67*h*. Return to an Address to His Royal Highness the Governor General of the 20th January, 1913, for a copy of all documents and memorials of the government of British Columbia presenting claims for additional provincial subsidies, and of all correspondence and orders in council on the same. Presented 16th April, 1913.—*Sir Wilfrid Laurier*.............................. ....*Printed for sessional papers.*

67*i*. Copy of agreement made with the several provinces as to the expenditure of the subsidies granted under the Agricultural Aid Act, and statement showing the purposes for which said subsidies are to be expended. Presented 6th June, 1913, by Hon. Mr Burrell.... ....*Not printed*

68. Copies of general orders promulgated to the militia for the period between 2nd November, 1911, and 5th Novmber, 1911. Presented by Hon. Mr. Hughes, 14th January, 1913. *Not printed.*

69. Return to an Address to His Excellency the Right Honourable Sir Charles Fitzpatrick, P.C., &c., administrator, of the 31st March, 1913, for a copy of all papers, documents, petitions, letters, telegrams, orders in council and other papers and documents in possession of the Department of Customs, relating to the duty payable on twine used for fishing purposes, and especially relating to the construction placed upon item 682 of the Customs Tariff. Presented 23rd May, 1913.—*Mr. Sinclair*..........*Not printed.*

70. Return to an Order of the House of the 30th November, 1912, for a return showing:—

1. The date when the present Canadian Pure Food Act, now known as the Adulteration Act, R.S.C., was enacted.

2. What foods, beverages or drugs have standards of strength and purity under the Act been fixed, and what are the dates when such standards become operative.

3. What foods, beverages or drugs have standards of strength and purity been prepared and recommended from time to time by the chief analyst, which have not been put in force, and why were such standards not put in force.

4. How many cases of adulteration together with cases which show standards of quality below those required by the Adulteration Act, have been ascertained by the Dominion analyst since the said Act came into operation.

5. In how many of such cases did prosecutions under the Act or under the Criminal Code follow, and in how many cases were convictions secured. Presented 14th January, 1913.—*Mr. McDonnell*........................ ....*Not printed.*

71. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, negotiations, proposals in writing and other papers and documents in the possession of the government, or any department thereof, relating to reciprocity in trade with the United States, bearing date between the 1st day of January, 1890, and the 31st day of December, 1891. Presented 14th January, 1913.—*Mr. Sinclair.* *Not printed*

72. Return to an Order of the House of the 4th December, 1912, for a copy of all letters, telegrams, &c., exchanged between the member for Bellechasse County and the Minister of Agriculture and the Postmaster General, concerning the appointment of an additional physician at the quarantine station of Grosse Ile. Presented 14th January, 1913.—*Mr. Lemieux*..................... ....*Not printed.*

72*a*. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendations and reports concerning the appointment of Doctor Pomminville, to the position of surgeon of the St. Vincent de Paul penitentiary, replacing Doctor A. Allaire. Presented 24th January, 1913.—*Mr. Wilson (Laval)*.............. ....*Not printed.*

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72*b*. Return to an Order of the House of the 10th December, 1912, for a copy of all letters, telegrams, correspondence and other documents relating to the appointment of Charles W. Hatfield, fishery officer on the Tusket River, Yarmouth County, N.S. Presented 27th January, 1913.—*Mr. Law*..*Not printed.*

72*c*. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, letters, requests, telegrams and other documents relating to the appointment of Louis Nadeau as postmaster at Ste. Christine, County of Bagot. Presented 4th February, 1913.—*Mr. Marcil*..*Not printed*

72*d*. Return to an Order of the House of the 29th January, 1913, for a copy of all orders letters, telegrams and other documents in connection with the appointment of Lt.-Col. Warburton, as administrative medical officer at the Charlottetown camp in 1912, and of all letters and telegrams asking for a change in the said appointment, and of all orders and other documents relating to his being superseded, and to the appointment of his junior, Lt.-Col. Jenkins, in his place. Presented 13th February, 1913.—*Mr. Macdonald*..................... ....*Not printed.*

72*e*. Return to an Order of the House of the 27th January, 1913, for a copy of all documents, letters, correspondence, recommendations, reports, &c., relating to the appointment of Mr. J. Begin as manager of the experimental farm at Ste. Anne de la Pocatière. Presented 13th February, 1913.—*Mr. Lapointe (Kamouraska)*....*Not printed.*

72*f*. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence exchanged between Dr. Marcotte, M. Lavallée, M.P., the Honourable the Postmaster General and the Minister of Agriculture, concerning the appointment of an additional medical officer at Grosse Isle quarantine station. Presented 19th February, 1913.—*Mr. Lemieux*.. .. ..*Not printed.*

72*g*. Return to an Order of the House of the 3rd March, 1913, for a copy of all letters, telegrams, recommendations and other papers in connection with the appointment of John Macdonald as Inspector of Inland Revenue for the Maritime Provinces, and of all letters, telegrams, applications, recommendations and other papers received from any other person or persons relative to the applications of other persons for the position. Presented 17th March, 1913.—*Mr. Macdonald*........................*Not printed.*

72*h*. Return to an Order of the House of the 17th February, 1913, for a copy of all letters, petitions, telegrams, recommendations and other papers and documents, in the possession of the Department of Marine and Fisheries, or any department of the government, relating to the appointment of F. W. Kelley, M.D., as port physician at Bridgewater, N.S. Presented 18th March, 1913.—*Mr. Law*......................*Not printed*

72*i*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a return showing all appointments to office under the Dominion government in the constituency of Edmonton from 10th October, 1911, to 21st November, 1912, with a statement of the salaries in each case, together with a copy of all correspondence, recommendation to council, orders in council, and all other papers or documents in any way connected with such appointments. Presented 28th March, 1913.—*Mr. Oliver* ....*Not printed.*

72*j*. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, recommendations, reports, memoranda and other documents bearing on the appointment of a general foreman, or other permanent or temporary officials, of the Department of Public Works in the County of Bonaventure since October, 1911, up to date, with the names, residences, duties and salaries of such appointees. Presented 2nd May, 1913.—*Mr. Marcil (Bonaventure)*................................*Not printed.*

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72*k*. Appointment of Mr. McCloskie as postmaster at Waukau, British Columbia.—(*Senate*) *Not printed.*

73. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a return showing all changes made in the Customs Tariff of Canada by order in council since the close of last session of parliament. Presented 14th January, 1913.............. ....*Not printed.*

74. Return to an Order of the House of the 9th December, 1912, for a return showing the quantity and value of molasses of cane, as defined in tariff item No. 137a, imported into Canada for the fiscal year ending 31st March, 1912, from each island of the British West Indies, which are parties to the Canada-West India Trade Agreement. Presented 14th January, 1913.—*Mr. Maclean (Halifax)*..........................*Not printed.*

75. Letter of the Honourable F. D. Monk, M.P., to the Right Honourable the Prime Minister, resigning his position as Minister of Public Works, and the letter of the Prime Minister in acknowledgment thereof. Presented by Hon. Mr. Borden, 14th January, 1913................. ....*Not printed.*

75*a*. Return to an Order of the House of the 26th May, 1913, for a copy of all letters, reports, documents and all other communications relating to the appointment of Colonel Crowe as Commandant of the Royal Military College and to his resignation of said position, or to the extension of his term of service or to the termination thereof, and of all papers or letters passing between the minister and Colonel Crowe, relative to his resignation or the failure to extend his term of service. Presented 3rd June, 1913.—*Mr. Macdonald*..*Not printed*

75*b*. Return to an Order of the House of the 26th May, 1913, for a copy of all letters, reports, complaints and other communications and documents which passed between General McKenzie and the Minister of Militia or his department, previous to, and which led up to the resignation of General McKenzie; and also a copy of said resignation, and the reply of the minister thereto, and of any and all communications had with the War Office thereto, and of all other papers and documents in connection therewith. Presented 4th June, 1913.—*Mr. Macdonald*......................*Not printed.*

76. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, letters, telegrams, complaints and reports, bearing on the delay in the payment of census enumerators in the County of Bonaventure, in connection with the last census, together with the names, residences, amounts, and dates of payment. Presented 15th January, 1913.—*Mr. Marcil (Bonaventure)*..................................*Not printed.*

77. Report of departmental commission on the official statistics of Canada. Presented 15th January, 1913 ....*Printed for distribution only.*

78. Return to an Order of the House of the 18th March, 1912, for a copy of all correspondence in the possession of the Postmaster General respecting the change of name of Broderick post office in the Province of Saskatchewan, to St. Aldwyn. Presented 15th January, 1913......................... ....*Not printed.*

78*a*. Return to an Order of the House of the 30th November, 1911, for a copy of all papers, telegrams, letters, &c., between the Postmaster General and any other person respecting the closing or removal of the present post office at Spry Bay, Halifax County. Presented 20th January, 1913.—*Mr. Maclean (Halifax)*..........................*Not printed.*

79. Report of the commissioner Dominion Police Force, for the year 1912. Presented by Hon. Mr. Foster, 15th January, 1913..*Not printed.*

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80. Return to an Order of the House of the 9th December, 1912, for a copy of all correspondence, complaints, reports and all documents relating to the cancelling of lease No. 18778, consented to by the Honourable Minister of Railways and Canals, to Aurile Lebœuf, on the 12th December, 1910.—Presented 16th January, 1913.—*Mr. Papineau.* *Not printed*

81. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of all orders in council passed since 1st October, A.D. 1911, relating to the Board of Management of the Government Railways of Canada, or of any other member thereof, or in any way affecting the same, or any official of the Intercolonial Railway, as regards the duties to be performed or the powers to be exercised by the said Board or any member thereof, or by any such official, together with a copy of all recommendations, letters, applications, instructions, or other correspondence, in any manner relating thereto or having regard to the said orders in council as to the management of the Intercolonial railway. Presented 17th January, 1913.—*Mr. Emmerson*..*Not printed*

81*a*. Return to an Address to His Royal Highness the Governor General of the 4th December, 1912, for a copy of a certain Order in Council issued during the current year by which certain official reports formerly made to Board of Management of the Intercolonial Railway have been ordered in future to be made to Mr. F. P. Brady. Presented 17th January, 1913.—*Mr. Sinclair*..................................*Not printed.*

82. Return to an Order of the House of the 5th December, 1912, for a copy of all papers, including surveys, tenders, and every other record, or document in the possession of the Department of Railways and Canals or any other department of the government relating to the building of a line of railway from Estmere, County of Victoria, Province of Nova Scotia, to the town of Baddeck in the same county. Presented 17th January, 1913.—*Mr. McKenzie*..*Not printed.*

83. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all documents, papers, tenders, contracts, orders in council and correspondence in connection with the supply of castings for and the purchase of scrap iron from the eastern division of the Intercolonial Railway since 1st May, 1912. Presented 17th January, 1913.—*Mr. Maclean (Halifax)*....................*Not printed.*

83*a*. Return to an Order of the House of the 9th December, 1912, for a return showing the names of the employees on the dining cars of the Intercolonial Railway and the nature of their employment; and also of the employees on the Pullman cars of the Intercolonial Railway and the nature of their employment. Presented 17th January, 1913. —*Mr. Boulay*..*Not printed.*

83*b*. Return to an Order of the House of the 9th December, 1912, for a copy of all papers documents, telegrams, letters, &c., relating to a strike of temporary employees of the Intercolonial Railway at Halifax, in August, 1912. Presented 27th January, 1913.—*Mr. Mclean (Halifax)*..*Not printed.*

83*c*. Return to an Order of the House of the 10th December, 1912, for a copy of all evidence plans, reports, correspondence, &c., respecting an inquiry held concerning an accident on the Intercolonial Railway at St. André de Kamouraska on 7th October, 1912, caused by train No. 33, the maritime express going west. Presented 27th January, 1913.—*Mr. Lapointe (Kamouraska)*..................................*Not printed.*

83*d*. Return to an Order of the House, of the 29th January, 1913, for a copy of the evidence taken at the inquiry held in the month of November, 1912, by Mr. MacDonald

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superintendent of the Intercolonial at Lévis, in reference to Alfred Laugnay, an employee of the Intercolonial at St. Charles, County of Bellechasse. Presented 27th February, 1913.—*Mr. Lapointe (Kamouraska)*..............................*Not printed.*

83*e*. Return to an Order of the House of the 19th February, 1913, for a copy of all telegrams, letters, petitions, reports of engineers, plans, surveys, and other documents in the possession of the Department of Railways and Canals, and having been received since 1st January, 1912, relating to the construction of a branch line of the Intercolonial Railway into Guysborough County. Presented 18th March, 1913.—*Mr. Sinclair*..*Not printed.*

83*f*. Return to an Order of the House of the 24th February, 1913, for a copy of all petitions, resolutions, letters, telegrams and correspondence, relating to free or reduced transportation of hay over the Intercolonial Railway for the farmers of Antigonish County, Nova Scotia, and also of the evidence taken and report made as to the shortage of hay in that and other of the eastern counties of Nova Scotia. Presented 18th March, 1913.—*Mr. Chisholm (Antigonish)*.......................................*Not printed.*

83*g*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters telegrams, tenders, acceptances of tenders, cancellation of tenders and other papers and documents in the possession of the Department of Railways and Canals, or any department of the government, bearing date after 1st July, 1912, relating to the supply of ice for the use of the Intercolonial Railway at Mulgrave, N.S. Presented 18th March, 1913.—*Mr. Sinclair*...*Not printed.*

83*h*. Return to an Order of the House of the 12th February, 1913, for a copy of all letters correspondence, petitions and other documents, on file in the Department of Railways and Canals, or in the office of the Intercolonial Railway at Moncton, relating or in any way appertaining to the new public wharf at Sackville, N.B., and the necessity of establishing in the interest of the traffic of the Intercolonial Railway, and of the shipping and trade facilities of Sackville, and of the commerce of communities adjacent thereto, rail connections between the said wharf and the main line of the said railways at Sackville station; also of all letters and other communications received by the chairman or vice-chairman of the Government Railways Managing Board, or by any official of the said railway, relating in any manner to the said subject, received by them or any of them during the years 1911, 1912 and 1913. Presented 19th March, 1913.—*Mr. Emmerson*...*Not printed*

83*i*. Return to Order of the House of the 19th March, 1913, for a return showing who the tenderers were, and the amount of each tender for the supply of castings for the Intercolonial Railway during the present year. Presented 28th March, 1913.—*Mr. Macdonald*...*Not printed.*

83*j*. Return to an Order of the House of the 19th March, 1913, for a return showing how many kegs of nails were purchased in 1912 for the Intercolonial Railway; the prices paid therefor in each case; whether tenders were invited in the case of each purchase and, if so, who the respective tenderers were and the prices submitted; to whom were the contracts awarded in each case. Presented 28th March, 1913.—*Mr. Murphy.* *Not printed.*

83*k*. Return to an Order of the House of the 19th March, 1913, for a return showing the amounts received by the Intercolonial Railway for freight and passengers respectively for each of the twelve months of the calendar years 1910, 1911 and 1912, at the following stations:—Montreal, Halifax, St. John, Sydney, Truro, Moncton, New Glasgow

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and Amherst; also, the total receipts of the said railway for freight and passengers respectively during each of the said years. Presented 28th March, 1913.—*Mr. Rhodes.* *Not printed.*

83*l*. Return to an Order of the House of the 20th January, 1913, for a copy of all letters correspondence, telegrams, representations, requests and reports on file in the Department of Railways and Canals, or in the offices of the Intercolonial Railway at Moncton, or among the records of the Government Railways Managing Board, or in the office of the assistant chairman of the Government Railways Managing Board, relating to or in any way connected with the water supply system at Dorchester station on the Intercolonial railway, or relating to the absence of and the total failure to provide a supply of water for drinking or other purposes at that station, or in connection with the dwelling of the station agent in the Station House; and also of all correspondence, letters, requests, recommendations and reports relating to the alleged necessity of additional clerical or other help or assistance at the station. Presented 21st April, 1913.—*Mr. Emmerson*.................. ....*Not printed.*

83*m*. Return to an Order of the House of the 12th February, 1913, for a copy of all correspondence, letters, telegrams, reports and other papers on file in the Department of Railways and Canals, or in the offices of the Intercolonial Railway at Moncton, relating to M. L. Tracy, an employee of the mechanical department of the Intercolonial during the years 1899 and 1900, and of all letters and correspondence relating to the case of the said M. L. Tracy, passing between the then Minister of Railways and Canals and any of the officials of the railway, during those years; also a copy of the letters of D. Pottinger, then general manager, the late James E. Price, then general superintendent, and the late M. Jarvis, then a divisional superintendent of said railway, relating to the same subject during the said period of 1899 and 1900. Presented 21st April, 1913.—*Mr. Emmerson*..*Not printed.*

83*n*. Return to an Order of the House of the 3rd March, 1913, for a statement of all amounts collected by the Intercolonial Railway for freight on hay carried from Amherst and other stations on the Intercolonial, County of Cumberland, to Antigonish, N.S., and consigned to C. Edgar Whidden or C. B. Whidden & Son, in the month of January last and February instant, and by whom such freight was paid; also a copy of all way bills and bills of lading for the same. Presented 21st April, 1913. —*Mr. Chisholm (Antigonish)*...*Not printed.*

83*o*. Return to an Order of the House of the 3rd February, 1913, for a copy of all letters petitions, telegrams, complaints, communications, reports and other papers and documents, received since the 1st day of October, 1911, by and now in the possession of the Department of Railways and Canals, the Government Railway Managing Board or any official of the Intercolonial Railway or of the Prince Edward Island railway, relating to or in any manner appertaining to an application for, or a proposed reduction of the working hours for the Intercolonial railway employees at Moncton, or at any other point of the Intercolonial railway or the Prince Edward Island railway. Presented 21st April, 1913.—*Mr. Emmerson*......................................*Not printed.*

83*p*. Return to an Order of the House of the 24th February, 1913, for a copy of all complaints, requirements, requisitions, petitions, and correspondence of all kinds made by the Sydney, N.S., Board of Trade, or by the citizens of the city of Sydney, or any of them, having reference to better and increased facilities on the Intercolonial Railway on the Sydney division. Presented 21st April, 1913.—*Mr. Carroll.* *Not printed.*

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83*q*. Return to an Order of the House of the 31st March, 1913, for a copy of all letters, papers and other documents relating to the claim for damages for the death of the young son of Thomas Hoare, who was killed at a crossing of the Intercolonial Railway in the town of Stellarton in the summer of 1912, and of all petitions, letters, and other papers asking for the placing of gates or other protection at said crossing. Presented 1st April, 1913.—*Mr. Macdonald*..............................*Not printed*

83*r*. Return to an Order of the House of the 14th April, 1913, for a copy of all correspondence exchanged between the Department of Railways and Canals at Moncton and the same department at Campbellton, on the subject of the collision which occurred at St. Moise, during the month of February, 1913, between the trains of E. Smith and the regular train No. 99, omitting from it the inquiry held in the matter. Presented 29th April, 1913.—*Mr. Boulay*..............................*Not printed.*

83*s*. Return to an Order of the House of the 7th April, 1913, for a return showing the names, residences and occupations of all the employees of the Intercolonial Railway who have been dismissed in the County of Rimouski since the 21st September, 1911. Presented 29th April, 1913.—*Mr. Lapointe (Kamouraska)*..................*Not printed.*

83*t*. Certified copy of a report of the Privy Council of the 5th May, 1913, covering the appointment of Frederick Passmore Gutelius, as general manager of Government Railways. Presented by Hon. Mr. Cochrane, 7th May, 1913... .. .. ..*Not printed.*

83*u*. Return to an Order of the House of the 31st March, 1913, for a copy of all letters, memorials, petitions, correspondence, reports and other documents in the Department of the Postmaster General, or on file therein, relating or in any wise appertaining to the inauguration or establishing of railway mail facilities between Moncton, N.B., westward over the Intercolonial Railway towards St. John, in the morning, so as to furnish, among other things, opportunities for the transmission of newspapers and other mail matter, along said railway, to make morning connection with the railway mail facilities afforded by the railway from Salisbury. Westmorland County, N.B., running into Albert County, N.B.; and also relating to the establishment of railway mail facilities on each week day evening between Moncton eastward over the said railway by train known as number 84, running between Moncton, N.B., and Springhill Junction, Nova Scotia, thus affording the direct mail connection for newspapers and other mail matter each evening from Moncton to Shediac, Memramcook, Dorchester, Sackville, Amherst, and intermediate points east of Moncton; together with a statement showing what, if any, such railway mail facilities, either by locked bag or otherwise, were established or furnished over either of the said routes, and stating the respective dates when the same were so established or furnished generally, or in relation to any one of the newspapers published in Moncton, either in the morning or in the evening. Presented 12th May, 1913.—*Mr. Emmerson*......................*Not printed.*

83*v*. Return showing whether any contract has been made for the construction or supply of cars of any kind to the Intercolonial Railway since 1st January, 1913, and if so, to whom the contract was awarded; the number of cars, kind or class, and the price to be paid; whether any tenders were called for previous to awarding said contract, and if so, who the tenderers were, the amount of the tender in each case, and if tenders were calld for by private request or public advertisement. Presented 21st May, 1913. —*Mr. Macdonald*.................. ....*Not printed.*

83*w*. Return to an Order of the House of the 28th April, 1913, for a return showing all amounts collected by the Intercolonial Railway for freight on hay shipped from Amherst and other stations on the Intercolonial, in the County of Cumberland, to Antigonish and other stations in the County of Antigonish, during the months of

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January, February and March last; the name of the consigners and of the consignees, the amount of freight paid on each shipment and by whom paid; also a copy of all way-bills and bills of lading for same. Presented 6th June, 1913.—*Mr. Chisholm (Antigonish)*........................ ....*Not printed.*

84. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, documents, memoranda, orders in council, letters and correspondence, relating in any way to the closing of the Canadian Immigration Office at Boston, U.S.A., in 1911, and its subsequent re-establishment. Presented 17th January, 1913.—*Mr. McLean (Halifax)*.......................................*Not printed*

85. Copies of despatches dated 11th December, 1912, which have been addressed to the Governors General of the Commonwealth of Australia and the Union of South Africa and the Governors of New Zealand and Newfoundland, on the subject of representation of the self-governing Dominions on the Committee of Imperial Defence. Presented by Hon. Mr. Borden, 17th January, 1913............................*Not printed.*

86. Reports in connection with the Tides and Currents of Northumberland Strait.—(*Senate*)............. ....*Not printed.*

87. Archives Branch, *re* transferring of from Department of Agriculture to Secretary of State.—(*Senate*)................. ....*Not printed.*

88. Commission appointed to investigate Indian reserves of British Columbia.—(*Senate*).
Not printed.

89. Insurance rates between Canadian Atlantic ports, and ports in tho United Kingdom.—(*Senate*) ....*Printed for distribution and sessional papers.*

90. Report of departmental commission relating to official statistics of Canada.—(*Senate*).
Printe d for distribution only.

91. Copy of the Sixth Joint Report of the Commissioners for the Demarcation of the Meridian of the 141st degree of west longitude. Presented by Hon. Mr. Roche, 21st January, 1913................. ....*Not printed.*

92. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, petitions, memoranda, correspondence, &c., with the Government of British Columbia or any member thereof, with the fishery officers of the Marine and Fisheries Department resident in said province, with salmon canneries in said province, and with any company, person or persons, relating to the prohibition of the export of sockeye salmon from the said province of British Columbia since 15th October, 1911. Presented 20th January, 1913.—*Mr. Maclean (Halifax)*....*Not printed.*

93. Return to an Order of the House of the 20th March, 1912, for a copy of all correspondence and memoranda on the subject of cable rates, exchanged between the Canadian Post Office Department and the British Post Office Department. Presented 20th January, 1913.—*Mr. Lemieux*..*Not printed.*

94. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, documents, letters, &c., between the Government of Canada and the Commonwealth of Australia for the past twelve months relative to the matter of preferential tariff arrangements between the said two countries. Presented 21st January, 1913.—*Mr. Maclean (Halifax)..Printed for sessional papers only.*

95. Report of Mr. Olivar Asselin on an investigation of Belgian and French emigration to Canada. Presented by Hon. Mr. Roche, 21st January, 1913.
Printed for distribution and sessional papers.

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95a. Return to an Order of the House of the 4th December, 1912, for a copy of all complaints, letters, papers, reports, and of all documents bearing on the investigation held at Port Daniel West, Quebec, into the conduct of Edward Dea, as overseer or guardian of the lobster hatchery at that place. Presented 22nd January, 1913.—*Mr. Marcil* ....*Not printed.*

95b. Report of R. A. Pringle, Esq., K.C., in relation to the investigation of the wreck of the steamer *Mayflower*, on the 12th November, 1912. Presented by Hon. Mr. Hazen, 6th February, 1913..*Not printed.*

95c. Return to an Address to His Royal Highness the Governor General of the 29th January, 1913, for a copy of the report of the commission appointed to investigate complaints against the United Shoe Machinery Company, together with the order in council appointing the commission, the complaints upon which the order was issued and all action, if any, taken by the government on report of commission, by order in council or otherwise. Presented 11th February, 1913.—*Sir Wilfrid Laurier.*
Not printed

95d. Return to an Order of the House of the 20th January, 1913, for a copy of all evidence, letters, telegrams and other documents in connection with the investigation into the stranding of the D. G. steamer *Earl Grey* at Toney River, County of Pictou, in the spring of 1912; of the reports of the commissioner investigating the same, and of all correspondence, telegrams and documents in connection therewith, and of any departmental action in connection therewith. Presented 18th March, 1913.—*Mr. Macdonald*
Not printed

95e. Return to an Order of the House of the 27th January, 1913, for a copy of all letters, papers, evidence and other documents in connection with the investigation into the collision between the steamship *City of Sydney* and the tug boat *Douglas H. Thomas*, in Sydney Harbour, 13th November, 1912, and of the findings and reports of the commissioner holding the investigation in regard to the same. Presented 2nd April, 1913.—*Mr. Macdonald*..*Not printed.*

96. Report of the Second International Moral Education Congress held at the Hague, 22nd to 27th of August, 1912, and as related thereto, on moral instruction in the Canadian public schools, &c., by Mr. J. A. M. Aikins, who was appointed by the government to represent Canada at that Congress. Presented by Hon. Mr. Borden, 21st January, 1913..*Printed for distribution only.*

97. Return to an Order of the House of the 4th December, 1912, for a copy of all pay-lists, letters, documents, letters and other papers in connection with the expenditures at Cariboo Island in the County of Pictou. Presented 21st January, 1913.—*Mr Macdonald* ....*Not printed.*

98. Return to an Order of the House of the 22nd January, 1913, for a copy of all correspondence, letters and telegrams between the Minister of Marine and Fisheries, or any officer of his department, and J. A. Gillies, K.C., Sydney, relating to the purchase from John B. Nicholson, of a site for a salmon hatchery at Snidlope Lake, Richmond County, N.S., and also of all accounts, charges and vouchers received from the said J. A. Gillies, for services in connection therewith and the payments made to the said J. A. Gillies in respect of the same. Presented 7th February, 1913.—*Mr. Kyte.*
Not printed.

CONTENTS OF VOLUME 27—*Continued.*

99. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents and correspondence, between the Department of Public Works and any person or persons relating to the placing of obstructions in the waters of South West Cove, Lunenburg County, N.S. Presented 24th January, 1913.—*Mr. Maclean (Halifax)*............. ....*Not printed.*

100. Return to an Order of the House of the 4th December, 1912, for a copy of all pay-lists, letters, documents, telegrams and other papers in connection with the expenditures at Skinner's Cove in the County of Pictou. Presented 24th January, 1913.—*Mr. Macdonald* ....*Not printed.*

101. Return to an Address to His Royal Highness the Governor General of the 22nd January, 1912, for a copy of all correspondence between the government of Canada and the government of the Province of Ontario, with regard to the extension of the boundaries of the said province. Presented 28th January, 1913.—*Sir Wilfrid Laurier.* *Not printed.*

102. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, reports, and documents, bearing on the claim of C. R. Scoles, of New Carlisle, Quebec, to a balance of subsidy voted to the Atlantic and Lake Superior railway, since October, 1911, to date. Presented 24th January, 1913.—*Mr. Marcil.* *Not printed.*

103. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, letters, telegrams, reports and other documents concerning an alleged defalcation in the accounts of Joseph J. Melanson, clerk in the customs office at Bathurst, County of Gloucester, which caused an inquiry to be held on the 23rd of October last by the Provincial Inspector of Customs, with the name of the accuser. Presented 24th January, 1913.—*Mr. Turgeon*..........................*Not printed.*

104. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, letters and telegrams in the custody of the Department of Railways and Canals, or any other department of the government, between the 1st day of September, 1874, and the 1st day of September, 1879, relating to the acquisition or expropriation of lands at St. Peters, N.S., for canal purposes, and relating to the appointment of valuators to apprise the value of such lands; the instructions to such valuators, the report or reports of such valuators, the area of lands taken, and the price paid for same; and also the amount paid each valuator for his services. Presented 27th January, 1913.—*Mr. Kyte*...*Not printed.*

105. Return to an Order of the House of the 4th December. 1912, for a copy of all the different freight tariffs in force on the line of railway from Matapedia, Quebec, to New Carlisle, Quebec, and from New Carlisle, to Gascons, Quebec, and vice versa, and of any requests that have been received in regard to the change in the same; and also a copy of any requests, petitions, letters, or other documents complaining of the said tariffs. Presented 27th January, 1913.—*Mr. Marcil (Bonaventure).* *Not printed.*

105*a*. Return to an Order of the House of the 10th December, 1912, for a copy of the different freight tariffs in force on the line of railway from Sunny Brae to Ferrona Junction, on the Intercolonial Railway, and of any requests that have been received in regard to the change in the same, and also a copy of any requests, petitions, letters or other documents complaining of said tariff. Presented 27th January, 1913. —*Mr. Sinclair*.................... ....*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

106. Return to an Order of the House of the 5th December, 1912, for a copy of the original instructions, including maps, specifications, profiles, &c., furnished the engineers on the eastern division of the Transcontinental railway between Winnipeg and Quebec by the chief engineer of the Transcontinental Commission, and approved by the Grand Trunk Pacific Railway Company. Also of all instructions, including specifications and profiles, issued by the chief engineer of the Transcontinental Commission or by the chairman, since 31st October, 1911, which in any way vary, amend, or depart from the original instructions above mentioned. Also, of all correspondence between the Minister of Railways or any official of his department and the chairman of the Transcontinental Commission, or the chief engineer, concerning the departure from the original instructions, either as to the grades, curves and bridges or other permanent structures. Also a copy of all correspondence between the Minister of Railways or any member of the government and any official of the Grand Trunk Pacific Railway Company referring to change of original instructions as regards grades, curves or permanent structures on the said line between Winnipeg and Quebec; and also of all correspondence between the chairman of the Transcontinental Commission or the chief engineer and any official of the Grand Trunk Pacific Railway Company, or any member of its engineering staff, concerning the proposed change of grades, curves, or other permanent structures on the line of the Transcontinental between Winnipeg and the City of Quebec. Presented 30th January, 1913—*Mr. Graham.*
Not printed.

106*a*. Return to an Order of the House of the 7th May, 1913, for a copy of a letter, dated 24th September, 1904, written by Chief Engineer Lumsden of the Transcontinental Commission to Chairman Wade of the same body, in which the former recommended to the latter certain grades on the Transcontinental railway. Presented 15th May, 1913.—*Mr. Graham*.................... ....*Not printed.*

107. Return to an Order of the House of the 20th January, 1913, for a copy of all papers in connection with a claim of L. A. Sauvé to certain buildings at La Pointe des Cascades, on the Soulanges canal, and of all correspondence on the same. Presented 30th January, 1913.—*Sir Wilfrid Laurier*................................*Not printed.*

108. Return to an Order of the House of the 5th December, 1912, for a copy of the contract entered into between the Department of Railways and Canals and W. H. Weller for St. Peters canal improvements, and for a copy of all correspondence between the contractor or any other person, firm or corporation and the Honourable Minister of Railways and Canals relating to the dumping of material removed by the contractor. Presented 30th January, 1913.—*Mr. Kyte*................................*Not printed.*

108*a*. Return to an Order of the House of the 27th January, 1913, for a copy of all correspondence between the Department of Railways and Canals and C. D. Sargent, C.E., and between C. D. Sargent, C.E., and H. G. Stanton, Superintending Engineer of the St. Peters Canal, or between W. H. Weller, contractor for the St. Peters canal improvements, and either or all of said parties relative to work done by the contractor outside of his contract, and the specifications thereof, and also a copy of all correspondence, letters and telegrams between the Department of Railways and Canals or C. D. Sargent, C.E., and any other person, in regard to the same; and of all accounts and vouchers rendered by the contractor to the government of such work, and the payment made by the government to the contractor, specifying whether the same is paid for in full or otherwise. Presented 21st April, 1913.—*Mr. Kyte.*
Not printed.

108*b*. Return to an Order of the House of the 19th March, 1913, for a copy of the accounts of personal expenses paid to Mr. St. Amour, Superintendent of the Soulanges Canal,

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since he entered upon his duties.—Also return to an Order of the House of the 2nd April, 1913, for a copy of all accounts for personal expenses paid by the government to Mr. St. Amour, Superintendent of the Soulanges Canal, since the date of his appointment. Presented 29th April, 1913.—*Mr. Boyer*......................*Not printed.*

109. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, letters, telegrams, petitions and other documents received since the 1st day of January, 1912, asking that the line of railway known as the Vale Road, should be taken over by the Intercolonial Railway. Presented 30th January, 1913.—*Mr. Macdonald*...*Not printed.*

110. Return to an Order of the House of the 27th January, 1913, for a copy of all correspondence in connection with the issuing of letters patent to the Quebec Railway, Light, Heat and Power Company, Limited, and also said letters patent. Presented 30th January, 1913.—*Mr. Lemieux*..*Not printed.*

111. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, correspondence, &c., between the Department of Trade and Commerce and Mr. Donnelly, late Canadian Trade Commissioner in Mexico, relating to the closing of the office of such trade commissioner in Mexico. Presented 3rd February, 1913.—*Mr. Maclean (Halifax)*..*Not printed.*

112. Return called for by Section 88 of Chapter 62, Revised Statutes of Canada, requiring that the Minister of the Interior shall lay before parliament, each year, a return of liquor brought from any place out of Canada into the territories by special permission in writing of the Commissioner of the Northwest Territories. Presented by Hon. Mr. Roche, 3rd February, 1913..*Not printed.*

113. Return to an Order of the House of the 22nd January, 1913, for a copy of all letters, telegrams and other papers and documents, relating to the resignation of Lt.-Col. W. F. Moore, 20th Regiment, Halton Rifles, and also of the resignation and the reply thereto. Presented 6th February, 1913.—*Mr. Macdonald*...............*Not printed.*

114. Return to an Order of the House of the 20th January, 1913, for a copy of all letters, papers, telegrams and other documents in connection with the strike of firemen and other men employed on the D.G.S. *Earl Grey*, in the year 1912 and 1913. Presented 11th February, 1913.—*Mr. Macdonald*.................................*Not printed.*

115. Return to an Order of the House of the 27th March, 1912, for a copy of all papers, letters and telegrams relating to the applications for, or the granting of, a lease of False Cove Flats, Vancouver, B.C. Presented 11th February, 1913.—*Mr. Macdonald.* *Not printed.*

116. Return to an Order of the House of the 27th January, 1913, for a copy of all correspondence and other papers in connection with a proposed guarantee of bonds to the Quebec and Saguenay railway. Presented 11th February, 1913.—*Mr. Lemieux*....*Not printed.*

116a. Return to an Order of the House of the 9th April, 1913, for a copy of all documents, including petitions, memorials, letters and telegrams, addressed to the government, or any of its members, urging it to take over and incorporate into the Canadian government railway system, the Quebec and Oriental Railway and the Atlantic, Quebec and Western Railway, with a copy of all the answers thereto. Presented 20th May, 1913. —*Mr. Marcil (Bonaventure)*..*Not printed.*

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116*b*. Return to an Address to His Royal Highness the Governor General of the 11th December, 1912, for a copy of all orders in council in connection with the construction of a line of railway from St. John to Grand Falls in the Province of New Brunswick, or any portion thereof and also of all plans and profiles filed with the Department of Railways and Canals by the St. John and Quebec Railway Company, and of all correspondence between the Department of Railways and Canals or any official thereof and with the said company or the Government of the Province of New Brunswick, or any official thereof, with reference to the curves, grades or general specifications of the said railway or any portion thereof. Presented 20th May, 1913.—*Mr. Carvell.* *Not printed*

116*c*. Return to an Order of the House of the 28th April, 1913, for a copy of all memorials, petitions, letters, and other documents submitted to the Board of Railway Commissioners from 1st January, 1913, to date, by any party whatsoever regarding the service of the Quebec and Oriental Railway and the Atlantic, Quebec and Western Railway, as to freight, passengers and express matters, with a copy of all orders and rulings issued by such Board and of all correspondence in connection therewith. Presented 20th May, 1913.—*Mr. Marcil (Bonaventure)*..............................*Not printed.*

117. Return to an Address to His Royal Highness the Governor General of the 5th December. 1912, for a return showing the number of appeals made to the Governor in Council during the twelve months preceding 25th November, 1912, against orders of the Board of Railway Commissioners, the particulars of each appeal, and the decision rendered by the Governor in Council in each case. Presented 11th February, 1913.—*Mr. Graham* ....*Printed for sessional papers only.*

118. Return to an Address to His Royal Highness the Governor General of the 22nd January, 1913, for a copy of all orders in council and of all correspondence relating to the extension of facilities for obtaining information useful to Canadian Trade and Commerce in connection with the British Consular Service. Presented 11th February, 1913.—*Mr. Ames*.................. ....*Not printed.*

119. Return to an Order of the House of the 24th January, 1913, for a return showing all the employees of the different departments at Ottawa, and also in the nine provinces and territories of Canada, and other places outside of Canada, in the inside and outside service, who have left their employment since the 1st October, 1911, up to the 10th January, 1912, inclusively, with their names, Christian names, age, nationality, employment and salaries respectively; the date of their appointment; the date of their leaving; their salaries, the time of their appointment and at leaving; the reasons of their leaving; and if replaced or not; the names, Christian name, age, nationality, employment and salary of those who have replaced them; and in the case of dismissals, a list of the persons who asked for their dismissals; in the case of these replacing them, a list of the persons who recommended their successors Presented 11th February, 1913.—*Mr. Wilson (Laval)*..................................*Not printed.*

119*a*. Supplementary return to an Order of the House of the 24th January, 1912, for a return showing all the employees of the different departments at Ottawa, and also in the nine provinces and territories of Canada, and other places outside of Canada, in the inside and outside service, who have left their employment since the 1st October, 1911, up to the 10th January, 1912, inclusively, with their names, Christian names, age, nationality, employment and salaries respectively; the date of their appointment; the date of their leaving; their salaries at the time of their appointment and at leaving; the reasons of their leaving; and if replaced or not; the names, Christian name, age, nationality, employment and salary of those who have replaced them;

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and in the case of dismissals, a list of the persons who asked for their dismissals; in the case of these replacing them, a list of the persons who recommended their successors. Presented 17th March, 1913.—*Mr. Wilson (Laval)*............*Not printed.*

120. Return to an Address to His Royal Highness the Governor General of the 5th February, 1912, for a copy of all tenders, contracts, reports and other memoranda of the engineers of the Department of Public Works, orders in council, correspondence and all other documents relating to the construction of a dam for storage purposes at the foot of Lake Timiskaming. Presented 12th February, 1913.—*Mr. Pugsley.* *Not printed.*

120*a*. Return to an Order of the House of the 4th March, 1912, for a copy of all contracts, correspondence or writings whatsoever, respecting the construction of a dam in 1908 or 1909, called the Lake Timiskaming dam constructed or built over the rivers forming the inflow or the discharge of the said lake, exchanged between the Government of Canada and the contractor or contractors. Presented 12th February, 1913.—*Mr. Boulay*.................. ....*Not printed.*

121. Return to an Order of the House of the 28th March, 1912, for a return giving a list of the subjects of the oil paintings and water colours which have become the property of the National Gallery of Canada since 1891; and the names of the artists in each case. Presented 12th February, 1913.—*Mr. Burnham*......................*Not printed.*

122. Return to an Order of the House of the 27th January, 1913, for a copy of all documents, letters, correspondence, reports, recommendations, &c., relating to the petition of Mr. Firmin Thibault, of St. Denis, County of Kamouraska, for his indemnity for having served at the time of the Fenian invasion. Presented 13th February, 1913 —*Mr. Lapointe (Kamouraska)*...................... ....*Not printed.*

123. Return to an Order of the House of the 27th January, 1913, for a return showing what date or dates the government purchased the site for the new Dominion Rifle Range in the County of Carleton, Ontario, from whom were the several parcels of land purchased, and what price per acre was paid for each, the number of acres of land purchased, and the total amount paid therefor, if any buildings have been erected on the said lands by the government, and the cost thereof, the amounts paid by the government for commissions, fees, agency charges, and legal expenses, and to whom in connection with said purchase, the amount of money expended by the Government on the said range for all purposes, from the date of the original purchase of the land up to 23rd January, 1913, and any sums remaining to be paid in any way connected with the purchase of the said range, to whom and the respective amounts thereof, the distance from the post office in the City of Ottawa to the said range, if any line of electric or other railway runs from the City of Ottawa to the said range, and what means of transportation will be provided for riflemen going to and returning from the said range. Presented 13th February, 1913—*Mr. Wilson (Laval)*..............*Not printed.*

124. Return to an Address to His Royal Highness the Governor General of the 10th February, 1913, for a copy of the memorial presented to the Government during the session of 1911-12, by a delegation from the Government of Prince Edward Island asking for an increased provincial subsidy, a copy of which memorial was laid on the Table of the House by the Finance Minister last session of Parliament, but is not now apparently on the files of the House Presented 17th February, 1913.—*Mr. Hughes (Kings, P.E.I.)*..*Printed for sessional papers only.*

125. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, letters, telegrams and correspondence between the Government of Canada or any member thereof, since 1st November, 1911, to the pre-

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sent time, with any corporation, company, party or parties, in any way relating to the Customs Tariff upon cement or to the temporary reduction made of the Customs Tariff upon cement; also for a copy of all letters and correspondence by and between members of the Government of Canada during the same period relating to the same subject, and of all papers, documents, memoranda and orders in council relative to the reduction of the Customs Tariff upon cement made by order in council since the close of the last session of parliament. Presented 17th February, 1913.—*Mr. Maclean (Halifax)*............................ ....*Not printed.*

125*a*. Return to an Address to His Royal Highness the Governor General of the 20th January, 1913, for a copy of all petitions since the 1st of October, 1911, addressed to the Governor General in Council or to any member of the government, asking for a remission and the adjustment of duty on cement, of all letters to the ministers individually on the same, of all correspondence and of all orders in council. Presented 21st February, 19.3.—*Sir Wilfrid Laurier*..................................*Not printed.*

125*b*. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all papers, documents, petitions, orders in council, letters and telegrams in any department of the government of Canada, or that passed between the Department of Customs and the Department of Justice or any solicitor, counsel, association, company or individual, during the past twelve months, respecting the imposition of tariff duties upon imported lumber dressed on one side and sized, or respecting the interpretation of tariff item No. 504, together with a printed copy of any stated case, appeal, factum or argument used before the Exchequer Court of Canada or the Supreme Court of Canada, in the matter of the judicial interpretation of tariff item No. 504. Presented 4th June, 1913.—*Mr. Maclean (Halifax)*
Not printed.

126. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence passing between the government or any member thereof with respect to the east half of Section 27 in township six (6) in range two (2) west of the third meridian. Presented 17th February, 1913.—*Mr. Martin (Regina)*.......................*Not printed.*

127. Return to an Order of the House of the 27th January, 1913, for a return showing when the militia or regular forces was first called out in Canada since Confederation in aid of the civil authorities, how often, when and where has the same been called out since, the amount of money paid by each municipal corporation for such service in each case, what corps called out on each occasion, whether to quell strikes in each instance or for what purpose. Presented 18th February, 1913.—*Mr. Macdonald.*
Not printed.

128. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, papers, &c., concerning the application by James McKelvey, of the town of Sarnia, Ontario, for Fenian Raid Volunteer Bounty. Presented 18th February, 1913.—*Mr. Macdonald*.................... ....*Not printed.*

129. Return to an Order of the House of the 10th February, 1913, for a copy of all documents, correspondence, memoraudums, reports, requests for inquiries, of the appointment of commissioners and other documents, relating to the study of the causes for the depopulation of country places and the high cost of living in the eastern provinces of the Dominion. Presented 18th February, 1913.—*Mr. Paquet*..........*Not printed.*

130. Return to an Order of the House of the 9th December, 1912, for a copy of all papers, documents, memoranda and correspondence relating to the application of the Banque Internationale to the Treasury Board for a certificate for the commencement of business. Presented 18th February, 1913.—*Mr. Maclean (Halifax)*..........*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

131. Return to an Order of the House of the 4th December, 1912, for a copy of all papers, documents, telegrams, reports, letters, and instructions regarding smelt and salmon fishing in the Restigouche river and the Baie des Chaleurs since October, 1911, up to date, together with copy of instructions issued to officials of the Department of Marine and Fisheries in that connection. Presented 18th February, 1913.—*Mr. Marcil (Bonaventure)*.......................... ....*Not printed.*

132. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence and papers concerning the increase of salary of Mr. Sevigny, employed at the immigration office at Montreal. Presented 18th February, 1913.—*Mr. Carvell.* *Not printed.*

133. Return to an Order of the House of the 5th February, 1913, for a return showing whether any order for goods has been given by the Department of Public Works since 1st October, 1911, at Montreal, Quebec, St. John and Halifax; tenders asked for in each case; orders for goods given without tenders; names of firms, and amounts in each case. Presented 19th February, 1913.—*Mr. Macdonald*................*Not printed.*

134. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence and other papers, in the Department of Public Works, concerning the awarding of a contract for a Welsh coal supply to the various Dominion public buildings in Montreal. Presented 19th February, 1913.—*Mr. Lemieux*....*Not printed.*

135. Return to an Order of the House of the 5th December, 1912, for a return showing how many dredging contracts were let by the Department of Public Works during the year 1911-12, the name of each tenderer and the amount of each tender. Presented 19th February, 1913.—*Mr. Lemieux*..*Not printed.*

135*a*. Return to an Order of the House of the 4th December, 1912, for a return showing the quantity by cubic yards of dredging made in the harbour of Bathurst by the dredge *Restigouche* during the months of May, June, July, August, September, October, and November of the year 1911, and during the same months in the year 1912. Presented 19th February, 1913.—*Mr. Turgeon*..*Not printed.*

135*b*. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, documents, recommendations and reports respecting the dredging Des Prairies river, the work done, depth, length and width of channel dredged, the list of men employed to perform that work, their salaries, and the amount of money spent on that work since the 1st of October, 1911, up to the 21st November, 1912. Presented 12th May, 1913.—*Mr. Wilson (Laval)*..................................*Not printed.*

135*c*. Return to an Order of the House of the 3rd March, 1913, for a copy of all documents, letters, reports of engineers and a detailed statement of expenditure in connection with dredging at Ste. Anne de Restigouche and Cross Point, Bonaventure County. Presented 4th June, 1913.—*Mr. Marcil (Bonaventure)*......................*Not printed.*

135*d*. Return to an Order of the House of the 19th March, 1913, for a return showing the amount of dredging done by the government dredges for private parties or firms in Prince Edward Island, during the season of 1912; the names of the parties or firms for whom this dredging was done; the number of yards of material dredged for each party or firm; the class of material dredged, and the price per yard the government charged for this dredging; who measured the material dredged, and whether it was scow measurement that was made; who recommended the said dredging to be done; if the resident engineer or any engineer was consulted in regard to the measuring, and if the resident engineer or any engineer had control over the matter at all. Presented 6th June, 1913.—*Mr. Hughes (Kings, P.E.I.)*........................*Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

136. Return to an Order of the House of the 9th December, 1912, for a copy of the accounts of Jean Baptiste Lena and of his wife, for work done to the public buildings at Valleyfield, Quebec, in May, 1912; also for a copy of all correspondence, reports and documents relating to the payment in full or a part of their accounts. Presented 19th February, 1913.—*Mr. Papineau*..*Not printed.*

137. Return to an Order of the House of the 4th December, 1912, for a return showing the amount of money expended in improving the channel of the Ottawa river between the city of Hull and the village of Masson. Presented 19th February, 1913.—*Mr. Devlin.* *Not printed.*

138. Return to an Order of the House of the 4th December, 1912, for a copy of all documents relating to the transferring of P. E. Amiot, resident engineer of the Department of Public Works, Bonaventure, Quebec, to the district of Chicoutimi and Saguenay, and the appointment in his stead, in Bonaventure County, of Charles E. Tache, of Chicoutimi, as resident engineer, with a copy of all the instructions given to the latter and his duties, residence and salary. Presented 19th February, 1913.—*Mr. Marcil (Bonaventure)*........................ ....*Not printed.*

139. Return to an Order of the House of the 4th December, 1912, for a copy of all petitions, correspondence, memoranda, reports, and resolutions of county or other municipal councils of Bonaventure County asking or objecting to certain public works in Bonaventure County since October, 1911, with the Minister of Public Works, or any member of the present administration, and replies made thereto. Presented 19th February, 1913.—*Mr. Marcil (Bonaventure)*.......................................*Not printed.*

140. British Canadian Loan and Investment Company, Limited, Toronto, for year 1911.—(*Senate*).................. ....*Not printed.*

141. Claims of present fish warden, Baker Lake, County of Madawaska, N.B.—(*Senate*). *Not printed.*

141*a*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, telegrams, reports, information, convictions and other documents in the possession of the Department of Marine and Fisheries or any officer thereof relating to the prosecution in the year 1910, against George Rowlings and James Rowlings, of Musquodoboit Harbour, County of Halifax, for a violation of the fishery regulations. Presented 21st May, 1913.—*Mr. Sinclair*...*Not printed.*

141*b*. Return to an Order of the House of the 29th January, 1913, for a copy of all papers, letters, telegrams and documents or other communications, had with the Department of Marine and Fisheries or any official thereof, in regard to the prosecutions against the following parties:—Samuel Stewart, Melvin Hart, Andrew McNeil, Thomas McNeil, Hugh Malcolm, Tom Moffatt, James Waddin, Samuel Wright and Dougald Higgins, of Westville, County of Pictou, for infractions of the Fisheries Act, and of any applications or letters relative to relief from the fines imposed or the return of the same; and also of all papers, letters, and other documents relating to a charge against Rod. Martin, of Westville aforesaid, a fishery guardian, for illegal fishing and other offences. Presented 21st May, 1913.—*Mr. Macdonald*...........*Not printed.*

141*a*. Claims of Messrs. Boulanger and Son, Montmagny, Quebec.—(*Senate*)....*Not printed.*

142. Copy of Report of Minister of Justice in *re* Florence Mining Company.—(*Senate*). *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

143. Instruction sent to the different Lieutenant Governors of different provinces of Canada, with commissions.—(*Senate*)................ ....*Not printed.*

144. Return to an Order of the House of the 15th January, 1913, for a copy of all papers, letters, documents, telegrams, reports and opinions in relation to the claim of William Iceton, of Purcell's Cove for a return of a boat from the Department of Marine and Fisheries or any other department. Presented 20th February, 1913.—*Mr. Macdonald* ....*Not printed.*

145. Return to an Address to His Royal Highness the Governor General of the 9th December 1912, for a copy of all papers, telegrams, letters and orders in council respecting the transfer of the property known as the Police Point Reserve to the corporation of the City of Medicine Hat, Alberta. Presented 20th February, 1913.—*Mr. Buchanan.* *Not printed.*

146. Return to an Order of the House of the 29th January, 1913, for a copy of the inquiry made by F. B. Atkinson, Lévis, as to an accident that happened to the horse of Arsene Lauzier, at Amqui, County of Rimouski, on the 19th February, 1912. Presented 20th February, 1913.—*Mr. Boulay*..................................*Not printed.*

147. Correspondence, memoranda, &c., in respect to the issue of a patent for the N. ½ of S. W. ¼ of section 8, in township 49, range 26, west of the 2nd meridian, to one Arthur Donaldson, bearing date the 19th November, 1912. Presented by Hon. Mr. Roche, 20th February, 1913.................. ....*Not printed.*

147*a*. Return to an Order of the House of the 12th February, 1913, for a copy of all letters, telegrams and other documents with respect to the north half of the southwest quarter of section eight (8), township forty-nine (49), range twenty-six (26), west of the second meridian, province of Saskatchewan, and the granting of a homestead entry for the said land to one Arthur Donaldson. Presented 6th June, 1913.—*Mr. Martin (Regina)*.................................... ....*Not printed.*

148. Return to an Order of the House of the 12th February, 1913, for a copy of all papers, reports and other documents relating to the delay of the Indian Department in issuing patents for lands purchased from the St. Peters band of Indians, and forming part of the St. Peters Indian reserve, Manitoba. Presented 25th February, 1913. —*Mr. Oliver*......................... ....*Not printed.*

149. Return an Address to His Royal Highness the Governor General of the 27th January, 1913, for a copy of all applications addressed to the Government by the Algoma Steel Company for remission of duties on rails imported by the said company at Fort William; of all correspondence on the same, of all evidence sought and obtained by the government and supplied by the company in support of its application; and of all orders in council ordering such remission of duties. Presented 25th February, 1913.—*Sir Wilfrid Laurier*.......................... ....*Not printed.*

150. Return to an Order of the House of the 24th February, 1913, for a return showing the stenographers and secretaries of the House of Commons, and the names of the members for whom each of them work. Presented 26th February, 1913.—*Mr. Boulay.* *Not printed.*

150*a*. Return to an Order of the House of the 31st March, ultimo, for a return giving the names and home addresses of the persons employed in the House of Commons as stenographers to members. Presented 1st April, 1913.—*Mr. Martin (Regina).* *Not printed.*

CONTENTS OF VOLUME 27—*Continued.*

151. Return to an Order of the House of the 16th January, 1913, for a return showing the number of bushels of grain and barrels or sacks of flour which were shipped from Montreal, Quebec, St. John, N.B., and Halifax, for twelve months preceding the 31st day of December, 1912; the kinds of each product respectively, and the quantities of said commodities at each of above points which were domestic and foreign. Presented 26th February, 1913.—*Mr. Bennett (Simcoe)*........................*Not printed.*

152. Return to an Order of the House of the 19th February, 1913, for a return showing in detail the quantity and values, respectively, of the imports and exports of Canada with Great Britain, United States, Australia and New Zealand, during the year ending 31st March, 1912, in horses, cattle, sheep, hogs, bacon, hams, fresh and salted beef, lard, tallow, mutton, canned meats, butter, cheese, eggs, poultry and apples. Presented 26th February, 1913.—*Mr. Sutherland*................................*Not printed.*

153. Return to an Address to His Royal Highness the Governor General of the 26th February, 1912, for a copy of all letters, documents and correspondence relating to action by the Government in regrd to the relief of the shareholders and depositors of the Farmer's Bank, and of the order in council appointing Sir William Meredith as Commisioner, and all correspondence in relation thereto. Presented 26th February, 1913. —*Mr. Macdonald*.......................... ....*Not printed.*

153a. Report of the Honourable Sir William Ralph Meredith, Kt., Commissioner appointed to make investigation into all matters connected with the Farmers Bank of Canada. Presented by Hon. Mr. White, 26th February, 1913.
Printed for distribution and sessional papers.

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(This volume is bound in three parts.)

153b. Report of Royal Commission authorized by orders in council dated 19th day of July, 1912, and the 5th day of August, 1912, to inquire into alleged complaints as to methods of weighing butter and cheese in Montreal, and also as to the methods of payment. Presented by Hon. Mr. Burrell, 30th May, 1913.
Printed for distribution and sessional papers.

154. Return to an Order of the House of the 27th January, 1912, for a return showing the amount of the subsidy paid to each of the four original provinces of the Dominion at Confederation, and the population on which such payment was based; the subsidy payable to each of the remaining five provinces on entering the union, and the population on which such payment was based; the sum added to the subsidy of any province as better terms, and the date which such addition was made respectively; the details of each readjustment of subsidies since 1867, and the yearly subsidy at present payable to each province, with the population on which such payment is based, and the original debt allowance, if any, respectively, placed to the credit of each province on entering the union. Presented 27th February, 1913.—*Mr. Sinclair.*
Printed for sessional papers only.

155. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence in regard to the disposition of the Marine Hospital at Pictou to the town of Pictou, or any other corporation or person. Presented 27th February, 1913.—*Mr. Macdonald*................. ....*Not printed.*

156. Return to an Order of the House of the 29th January, 1913, for a copy of all letters, tenders, contracts, papers and other documents in the possession of the Department of Marine and Fisheries relating to the making and cancellation of a contract or agreement between the said department and one Charles G. Giffin, of Isaac Harbour,

CONTENTS OF VOLUME 28.—*Continued.*

N.S., to perform certain services for the lobster hatchery at that place, and also relating to a subsequent agreement with one Philip McArthur to perform similar duties. Presented 27th February, 1913.—*Mr. Sinclair*..............................*Not printed.*

157. Return to an Order of the House of the 29th January, 1913, for a copy of all papers and correspondence concerning the claim of Charles Mennier, ex-Collector of Customs at Marieville, Quebec, for rent. Presented 28th February, 1913.—*Mr. Lemieux.* *Not printed.*

158. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, correspondence, documents and reports relating to the closing of the post office at Pomket river, Antigonish County, Nova Scotia, and the cancellation of the contract for the carrying of the mail between Heatherton and Pomket river. Presented 28th February, 1913.—*Mr. Chisholm (Antigonish)*..............................*Not printed.*

158a. Return to an Order of the House of the 27th January, 1913, for a copy of all letters, telegrams, petitions and other correspondence and documents received by the Post Office Department during the last twelve months from the honourable member for East Grey and others, relating to the closing of the post office at Harkaway, County of Grey province of Ontario, and of the proposed change in the mail service. Presented 27th March, 1913.—*Mr. Lanctot*..............................*Not printed.*

159. Claims put forth by and on behalf of Indians of British Columbia—Report of James T. McKenna on.—*(Senate)*..............................*Not printed.*

159a. Return to an Address to His Royal Highness the Governor General of the 20th January, 1913, for a copy of all correspondence between the Government of British Columbia and the Government of Canada concerning the rights and claims of the Indians in the province, and of all orders in council with regard to the same. Presented 14th May, 1913.—*Sir Wilfrid Laurier*..............................*Not printed*

159b. Return to an Order of the House of the 28th April, 1913, for a copy of all correspondence, reports and recommendations from Rev. R. L. Macdonald, Indian agent at Salmon River reserve, Richmond County, N.S., relating to the Indian school in said reserve; and of all correspondence and instructions from the Department of Indian Affairs to the said Indian agent, relating to the same; also a copy of all complaints, charges and reports against Miss Charlotte M. Devereaux, teacher of the said school, and of all correspondence and recommendations relating to the appointment of Earnest McNeil to succeed her, since 1st January, 1912. Presented 23rd May, 1913.—*Mr. Kyte*..............................*Not printed.*

159c. Return to an Order of the House of the 12th May, 1913, for a copy of the last surrender and of all papers, correspondence and other documents in connection with the surrender of part of the White Bear Indian Reserve; together with a copy of all letters and telegrams referring to this surrender by officials of the Department or others, and of the authority on which this surrender was taken, the number of acres surrendered, and how disposed of. Presented 23rd May, 1913.—*Mr. Bradbury.* *Not printed.*

159d. Return to an Order of the House of the 30th April, 1913, for a copy of all letters, papers, memoranda and other documents, dated since 1st January, 1912, relating to the Kitsilano Indian Reserve in the City of Vancouver. Presented 23rd May, 1913.—*Mr. Oliver*..............................*Not printed.*

160. Immigrants—number of, who settled in Canada, in 1911-12, and from whence.—*(Senate).* *Not printed.*

CONTENTS OF VOLUME 28.—*Continued.*

160*a*. Return to an Order of the House of the 7th May, 1913, for a return showing the number of immigrants coming into Canada during the year ending 31st March, 1913, inspected by the government medical inspectors; the total cost of such medical inspections; the number of medical doctors employed by the government during that period; the name, salary and location of each, including those resident in Ottawa. Presented 6th June, 1913.—*Mr. Schaffner*....................................*Not printed.*

161. Correspondence with Mr. V. Steffansson concerning northern expedition. Presented by Hon. Mr. Hazen, 3rd March, 1913....................................*Not printed.*

161*a*. Copy of order in council No. P.C. 406 of the 22nd February, 1913, with reference to Mr. V. Steffansson's proposed northern expedition. Presented by Hon. Mr. Hazen, 10th March, 1913....................................*Not printed.*

162. Return to an Address to His Royal Highness the Governor General of the 25th March, 1912, for a copy of all letters, requests, petitions, orders in council and other documents in the possession of the Department of Marine and Fisheries relating to the change in the fishery regulations by which steam trawlers were prohibited from participating in the fishing bounty. Presented 3rd March, 1913.—*Mr. Sinclair.*
Not printed.

162*a*. Return to an Address to His Royal Highness the Governor General, of the 10th February, 1913, for a copy of all petitions, correspondence, reports of experts or officers, of orders in council, minutes of council, and of other papers and documents in the possession of the Department of Marine and Fisheries, or any department of the government, relating to steam trawling on the Atlantic seaboard. Presented 15th April, 1913.—*Mr. Sinclair*....................................*Not printed.*

163. Return to an Order of the House of the 19th February, 19'3, for a copy of all correspondence, papers, accounts, vouchers, concerning the purchase and subsequent repairs of a private car by the Department of Militia and Defence, from the Canadian Northern Railway Company. Presented 3rd March, 1913.—*Mr. Lemieux.*
Not printed.

164. Return to an Order of the House of the 24th February, 1913, for a return showing separately the amount paid by the Department of Indian Affairs for medical attendance on account of the Indians on the Micmac reserve of Ste. Anne de Restigouche, Quebec, for each year from 1900 to 1913, inclusive, and to whom paid. Presented 10th March, 1913.—*Mr. Marcil (Bonaventure)*....................................*Not printed.*

165. Return to an Order of the House of the 19th February, 1913, for a copy of all correspondence, letters, telegrams and other documents relative to the sale of alleged Indian lands at Nyanza, riding of North Cape Breton and Victoria, N.S., to one Philip McDonald, such sale having taken place about the year 1877. Presented 17th March, 1913.—*Mr. McKenzie*....................................*Not printed.*

165*a*. Return to an Order of the House of the 7th May, 1913, for a return showing the number of acres surrendered by the Coté's Band of Indians, the number of acres sold by private sale, the number of acres still unsold; together with a copy of all letters from persons who made application for purchase of surrendered lands in Coté's reserve, or from any person on behalf of purchasers and replies thereto; and of all reports, letters or memoranda addressed to the Superintendent General of Indian Affairs, from any officer of the department respecting the private sale of said lands; also a copy of any document or documents covering the authority under which these lands were sold by private sale, and of all letters addressed to the department, or any officer of department, respecting the sale of said lands. Presented 3rd June, 1913.—*Mr. Bradbury*....................................*Not printed.*

CONTENTS OF VOLUME 28.—*Continued.*

166. Return to an Order of the House of the 12th February, 1913, for a copy of all letters, reports and other documents received by the Minister of Labour regarding labour conditions on the Grand Trunk Pacific between Tête Jaune Cache and Fort George. Presented 17th March, 1913.—*Mr. Oliver*..............................*Not printed*

167. Return to an Address to His Royal Highness the Governor General of the 3rd February, 1913, for a copy of all telegrams, letters and other documents passing between the Government of Canada, or any member thereof, and the Government of the Province of Saskatchewan, or any member thereof, with respect to chapter 17 of the statutes of Saskatchewan, 1912, being an Act to prevent the employment of female labour in certain capacities. Presented 17th March, 1913.—*Mr. Martin (Regina)*......*Not printed.*

168. Return to an Order of the House of the 10th December, 1912, for a copy of all correspondence, petitions and other papers received by the Prime Minister, or any member of the government, since the 1st April, 1912, in connection with the school system established in that portion of the Keewatin Territory annexed to the province of Manitoba. Presented 17th March, 1913.—*Mr. Macdonald*..................*Not printed.*

169. Return to an Order of the House of the 29th January, 1913, for a return showing the number of accidents to lock gates or bridges on the Welland Canal during the year ending 25th November, 1912, the nature of the accidents, the amount of damage in each case and the amount recovered by the Government from vessel owners in each instance. Presented 18th March, 1913.—*Mr. Graham*......................*Not printed.*

170 Return to an Order of the House of the 3rd March, 1913, for a copy of the contract passed on the 6th day of August, 1910, between the City of Quebec and the Transcontinental Railway Commissioners, for the acquisition by the latter of the property known as Champlain Market, to be used as a station and terminals for the said railway; of all the correspondence between the said city and the present Commissioner of the said railway, with the Minister of Railways, or any other Minister, with regard to the non-execution of the said contract by the said commission. Presented 18th March, 1913.—*Sir Wilfrid Laurier*....................*Printed for sessional papers only.*

171. Return to an Order of the House of the 29th of January, 1913, for a copy of all letters, correspondence, &c., respecting the request for suspension by H. Boulay, of J. Stahl, assistant inspector of immigration on the railway. Presented 19th March, 1913.—*Mr. Boulay* ....*Not printed.*

172. Return to an Order of the House of the 17th February, 1913, for a return showing the total area of land thrown open for pre-emption and purchased homesteads in each of the provinces of Saskatchewan and Alberta since the passing of the Dominion Lands Act of 1908; also the number of acres of such lands which have been disposed of by way of pre-emptions and purchased homesteads in each of the said provinces, the amount of principal money collected on account of such lands in each of the said provinces up to 31st December, 1912, and the amount of interest collected on account of such lands in each of the said provinces to 31st December, 1912. Presented 19th March, 1913.—*Mr. Martin (Regina)*......................................*Not printed*

173. Return to an Order of the House of the 10th February, 1913, for a copy of all letters, correspondence, memorials and other documents received by the Right Honourable the Prime Minister and the Honourable the Minister of Justice, since the 1st day of January, 1912, relating to the request by county court judges for an increase of salary and for an amendment to the Judges Act with respect to retiring allowances. Presented 26th March, 1913.—*Mr. Proulx*......................................*Not printed.*

CONTENTS OF VOLUME 28.—*Continued.*

174. Return to an Order of the House of the 13th February, 1913, for a return showing the names of the keepers in Portsmouth penitentiary, and their religious belief; the names of any of the said keepers who may have been dismissed, the date, charges and on whose recommendation were they reinstated. Presented 26th March, 1913.—*Mr. Edwards*..*Not printed.*

174a. Return to an Order of the House of the 13th February, 1913, for the name of the discipline officer in charge of each of the following departments in Portsmouth penitentiary, the date when each was first appointed on the penitentiary staff, the date to his present position, and the religious belief of each: Quarry, farm, warden's residence and grounds, blacksmith shop, bath room and laundry, stone shed, tailor and shoe shop, changing room, stone pile, sewage plant, asylum ward, cell wings, library and Roman Catholic and Protestant chapels, hospital, shop dome, carpenter, tin and paint shop, and prison of isolation. Presented 26th March, 1913.—*Mr. Edwards.* *Not printed.*

175. Return to an Order of the House of the 17th February, 1913, for a copy of all statements of account for salary or remuneration to the Commissioner, and his expenses, for witness fees and all other expenses in connection with the investigations by Commissioner Duchemin, of the following persons in Antigonish County namely: Patrick M. Decoste, deckhand SS. *Scotia*, Harbour au Boucher; William R. Fougère, sectionman, Harbour au Bouche; Allen Kinney, sectionman, Linwood; Hubert Myatte, sectionman, Tracadie; John McDonell, sectionman, Afton Station; John W. Malanson, sectionman, Afton; James Armstrong, sectionman, Heatherton; Charles Landry, sectionman, Pomket; William S. Landry, section foreman, Pomket; Colin McDonald, sectionman, James River; Archibald Chisholm, station agent, Heatherton; Joseph Benoit, station agent, Pomket; Alex. R. McAdam, fishery officer, Malignant Cove; Alex. McDonald, sub-collector, Doctors Brook; Charles L. Gass, sub-collector, Bayfield; Jeffrey M. Crispo, sub-collector, Harbour au Bouche; Hugh R. McAdam, postmaster, Arisaig; Thomas J. Sears, postmaster, Lochaber, Charles L. Gass, postmaster, Bayfield; and Joseph P. Benoit, postmaster, Pomquet; also the expenses in detail, of and incidental to the investigation by said Commissioner Duchemin of the charges made against John J. McDonald, postmaster, McArra's Brook; Archibald Stewart, section foreman, Harbour au Bouche; Ronald McFarlane, section foreman, Williams Point; Henry Williams, sectionman, Marshy Hope; and John W. McInnes, bridge foreman Intercolonial Railway, Antigonish. Presented 26th March, 1913.—*Mr. Chisholm (Antigonish)*..*Not printed.*

175a. Return to an Order of the House of the 28th April, 1913, for a return showing the date of the appointment of H. P. Duchemin, Investigating Commissioner for Eastern Nova Scotia; the number of days he has been employed by the government since the appointment; the gross amount paid to Mr. Duchemin as an allowance for his services, excluding travelling expenses or other outlay; the amount which has been paid to Mr. Duchemin to date for travelling expenses, living expenses, witness fees, and other sundry expenses, respectively. Presented 21st May, 1913.—*Mr. Sinclair.* *Not printed.*

176. Return to an Order of the House of the 4th December, 1912, for a copy of the report or reports made by C. E. Taché, resident engineer of Bonaventure County, Quebec, on public works existing or asked for in that constituency since October, 1911, up to date. Presented 28th March, 1913.—*Mr. Marcil (Bonaventure)*..................*Not printed.*

177. Return to an Order of the House of the 6th February, 1913, for a return showing what properties within the area north of Wellington street and west of Bank street, in the City of Ottawa, have been purchased or acquired by the Government; from whom the said purchases were made, and the price paid, or agreed to be paid, in each case; the

CONTENTS OF VOLUME 28.—*Continued.*

number of said properties not yet paid for, the names of the owners thereof, and amount, if any, in dispute in each case; the names of the persons who were employed in any capacity, or for any purpose, in connection with the purchase of the said properties, and the terms of their employment; the amount which has been paid to each, and further amounts to be paid to such persons, giving their respective names; whether the Government has employed any persons or agents to collect rent from the tenants or occupants of any of the said properties, if so, the names of such rent collectors, for what period employed, and amount by way of salary, fees, or commission, paid to each; the total amount paid by the Government up to 31st January, 1913, in connection with the purchase or acquisition of the said properties. Presented 28th March, 1913.—*Mr. Murphy* ....*Not printed.*

178. Return to an Order of the House of the 24th January, 1913, for a copy of all correspondence between the Minister of Public Works and H. Morel, M.P.P., for East Nipissing, in any way relating to the construction of a road or highway from North Bay to Sturgeon Falls, Ontario; and of all petitions, correspondence, surveys, and engineers' reports in any way connected with the building of the said road or highway. Presented 28th March, 1913.—*Mr. Murphy*..*Not printed.*

179. Return to an Order of the House of the 4th December, 1912, for a copy of all pay-lists, letters, documents, telegrams and other papers in connection with the expenditures made on Brulé wharf in the County of Colchester during the last two years. Presented 28th March, 1913.—*Mr. Macdonald*..................................*Not printed.*

179*a*. Return to an Order of the House of the 10th December, 1912, for a copy of all papers, documents, tenders and correspondence relating in any way to the construction of a wharf at Kraut Point, Lunenburg County, N.S. Presented 28th March, 1913. *Mr. Maclean (Halifax)*......................... ....*Not printed.*

180. Return to an Order of the House of the 29th January, 1913, for a copy of all correspondence, papers, &c., concerning the application made by the Eastern Canada Power Company, with a view to raise the head of the River St. Lawrence in the vicinity of Coteau, Cedar, Split Rock and Cascade rapids to the level of the water in Lake St. François. Presented 28th March, 1913.—*Mr. Lemieux*....................*Not printed.*

181. Return to an Order of the House of the 4th December, 1912, for a copy of all correspondence, letters and telegrams addressed by the Conservative candidate in the County of Gloucester at the election of 21st September, 1911, to the Minister of Public Works from the day he took his oath of office, on 10th October, 1911, up to the 31st December, of the same year, on the subject of public works then under construction in the said county. Presented 28th March, 1913.—*Mr. Turgeon*......*Not printed.*

182. Return to an Order of the House of the 10th March, 1913, for a return showing the number of men of the R. C. regiment at Aldershot, during the summer of 1912, previous to the regular militia camp; date of going into camp; number there during said time; whether tenders for supplies for these men were called for; number of tenders received and from whom; if any contracts were awarded on said tenders and, if not, what was done with the said tenders; how and from whom were supplies for these men obtained; the prices paid during said time per pound respectively, for meat, sugar, butter, tea, coffee bacon, bread, and how much per bushel for vegetables; the cost per ration for supplies for said men of the R. C. regiment at Aldershot camp during the time aforesaid; the cost per ration for supplies to the regular militia camp under contract during the annual drill in the fall of 1912. Presented 28th March, 1913.—*Mr. Kyte*..*Not printed.*

CONTENTS OF VOLUME 28.—*Continued.*

183. Report on wholesale prices in Canada, 1912, by R. H. Coats, B.A., F.S.S., editor of the *Labour Gazette.* Presented by Hon. Mr. Crothers, 28th March, 1913....*Not printed.*

184. Area of territories added to Ontario and Quebec, by Statutes of 1912.—(*Senate*). *Not printed.*

185. Relating to recent increase in prices charged Canadian fishermen for manilla cord.—(*Senate*)..*Not printed.*

186. Report of the Pilotage Commission of Quebec. Presented by Hon. Mr. Hazen, 28th March, 1913..*Not printed.*

187. Return to an Order of the House of the 26th February, 1913, for a copy of all memoranda, letters, papers, telegrams and other documents in the possession of the Department of the Interior relating to the S. W. 36-16-27, W. 2. Presented 31st March, 1913.—*Mr. Knowles*..*Not printed.*

187*a*. Return to an Order of the House of the 3rd March, 1913, for a copy of all correspondence, telegrams and other papers in connection with the southwest $\frac{1}{4}$ of 4-9-14 west of 2nd meridian. Presented 10th April, 1913.—*Mr. Bradbury*................*Not printed.*

187*b*. Return to an Order of the House of the 26th March, 1913, for a copy of all papers, letters, memoranda and other documents relating to the northwest of 30-25-7-2. Presented 25th April, 1913.—*Mr. Oliver*..*Not printed.*

187*c*. Return to an Order of the House of the 3rd March, 1913,—1. For a copy of all correspondence and other papers in connection with the disposal of the following lands and the claim of James W. Brown in connection with these lands:—

Part of S E. $\frac{1}{4}$ section 21-20-21-W. 2nd meridian, area $\frac{5}{100}$ths acre.
Part of N.E. $\frac{1}{4}$ section 21-20-21-W. 2nd meridian, area $\frac{116}{100}$ths acre
Part of S.E. $\frac{1}{4}$ section 20-20-21-W. 2nd meridian, area 80 acres.
Part of S.W. $\frac{1}{4}$ section 28-20-21-W. 2nd meridian, area 72$\frac{43}{100}$ths acres.
Whole of S.E. $\frac{1}{4}$ section 28-20-21-W. 2nd meridian, area 160 acres.
Whole of N.E. $\frac{1}{4}$ section 32-20-21-W. 2nd meridian, area 160 acres.
Part of S.E. $\frac{1}{4}$ section 32-20-21-W. 2nd meridian, area 80 acres.
Whole of N.W. $\frac{1}{4}$ section 5-21-21-W. 2nd meridian, area 160 acres.
Whole of S.E. $\frac{1}{2}$ section 5-21-21-W. 2nd meridian, area 160 acres.
Part of N.E. $\frac{1}{4}$ section 5-21-21-W. 2nd meridian, area 123$\frac{85}{100}$ths acres.
Whole of S.W. $\frac{1}{4}$ section 5-21-21-W. 2nd meridian, area 160 acres.

2. Also of all papers in connection with the disposal of the whole of the northwest quarter-section 22-20-21, west of the second meridian; and part of S.W. $\frac{1}{4}$, 2-20-21-W. of the second meridian; and of all correspondence and papers in connection with Alexander Hurst Brown's claim *re* these lands. Presented 30th April, 1913.—*Mr. Bradbury*..*Not printed.*

187*d*. Return to an Order of the House of the 9th April, 1913, for a copy of all letters, papers, telegrams and other documents in connection with the sale of the N.W. quarter-section 29 10-18-W. Presented 13th May, 1913.—*Mr. Turriff*......*Not printed.*

187*e*. Return to an Order of the House of the 28th April, 1913, for a copy of all letters, memoranda and other documents relating to the northeast quarter of 14-75-15-5, during the years 1911, 1912, and 1913 to date. Presented 13th May, 1913.—*Mr. Oliver.* *Not printed.*

CONTENTS OF VOLUME 23.—*Continued.*

187f. Return to an Order of the House of the 31st March, 1913, for a copy of all papers, telegrams, applications, and other documents in connection with the S.W. 2-19-20, west 2nd M. Homestead, patented 3rd June, 1892; the S. ½ of N.E. 20-20-21, west 2nd M. patented 11th October, 1901, N.W.H.B., as assignee of Edward Boucher; the S.E ¼ of 22-20-21, west 2nd M., N.W.H.B., patented 22nd September, 1900, as assignee of Louis McGillies; the S.E. ¼ of 28-20 21, west 2nd M., N.W.H.B., patented 26th August, 1901, as assignee of J. Bte. Fagant, jr., and the E. ½ of S.E. ¼ of 32-20-21, west 2nd M., N.W.H.B., patented 11th September, 1901, as assignee of Jos. Alexander; and of all papers in connection with any claims of G. W. Brown or others in connection with these lands. Presented 3rd June, 1913.—*Mr. Bradbury*....................*Not printed.*

187g. Return to an Order of the House of the 31st March, 1913, for a copy of all papers, telegrams, applications and other documents regarding the S.W. ¼, 28-20-21, west 2nd M., N.W.H.B., patented 1st March, 1909, as assignee of Norbert Bellehumeur; and the W. ½ of S.E. ¼, 32, 20, 21, west 2nd M., N.W.H.B., patented 1st March, 1909, as assignee of Norbert Bellehumeur; and of all papers in connection with any claims by Norman McKenzie or others against the Government in connection with these lands. Presented 4th June, 1913.—*Mr. Bradbury*..................................*Not printed.*

188. Return to an Order of the House of the 10th March, 1913, for a copy of all correspondence or communication of any kind between the Department of Insurance at Ottawa and the Department of Insurance at Toronto since June, 1907, touching the transfer of the Canadian Guardian Life Insurance Company from the jurisdiction of the Insurance Department at Ottawa to that of the jurisdiction of the Insurance Department at Toronto; of all correspondence, if any, between the Insurance Department at Ottawa and the *Saturday Night*, newspaper of Toronto, touching the affairs of the Canadian Guardian Life Insurance Company or the International Insurance Company, Limited; and of all correspondence and other communications between the Department of Insurance at Ottawa and the Government of the province of Alberta in reference to the affairs of the Canadian Guardian Life Insurance Company or the International Insurance Company, Limited. Presented 31st March, 1913.—*Mr. German.*
Not printed.

189. Copy of an Order in Council, &c., respecting a contribution of $30,000 to assist in alleviating the distress of the sufferers by the disastrous cyclone which swept over the City of Regina and its vicinity. Presented by Hon. Mr. White, 31st March, 1913.
Not printed.

190. Copy of correspondence respecting the Treaty of Commerce and Navigation between the United Kingdom and Japan. Presented by Hon. Mr. Borden, 1st April, 1913.
Printed for sessional papers only.

190a. From Imperial Consulate General of Japan for the Dominion of Canada. The undersigned, His Imperial Majesty's Consul General at Ottawa, duly authorized by His Government, has the honour to declare that the Imperial Japanese Government are fully prepared to maintain with equal effectiveness the limitation and control which they have since 1908 exercised in the regulation of emigration from Japan to Canada. 11th April, 1913. Presented by Hon. Mr. Borden, 11th April, 1913........*Not printed.*

191. Copy of the order in council in connection with the appointment of a Commission to inquire into the claims of the province of British Columbia for exceptional treatment. Presented by Hon. Mr. Borden, 1st April, 1913.......*Printed for sessional papers only.*

191a. Memorandum *re* British Columbia's claims for special consideration. Presented by Hon. Mr. Borden, 1st April, 1913......................*Printed for sessional papers only.*

CONTENTS OF VOLUME 28.—*Continued.*

191*b*. Copies of orders in council, &c., relating to the appointment of commissioners to adjust all matters relating to Indian lands and Indian affairs generally in the province of British Columbia. Presented by Hon. Mr. Borden, 17th April, 1913. *Not printed.*

191c. Report of the Royal Commission appointed to inquire into and report upon the law respecting pilotage and its administration in the pilotage districts of Montreal and Quebec; and what changes, if any, are desirable therein; and also, a letter addressed to the Minister of Marine and Fisheries from Mr. Ajutor Lachance, one of the commissioners. Presented by Hon. Mr. Hazen, 18th April, 1913................*Not printed.*

191*d*. Report of Royal Commission on Industrial Training and Technical Education, Parts I, II, III. and IV. Presented by Hon. Mr. Crothers, 4th June, 1913. *Printed for distribution and sessional papers.*

192. Return to an Order of the House of the 24th February, 1913, for a copy of all memoranda, letters, papers and documents relating to the setting apart of a forest reserve on the north side of the Saskatchewan river opposite the City of Prince Albert. Presented 2nd April, 1913.—*Mr. Oliver*..*Not printed.*

192*a*. Return to an Order of the House of the 26th February, 1913, for a copy of all memoranda, reports, letters, and other documents of any kind in the possession of the Department of the Interior relating to the suitability for forest reserve or for homesteading purposes, of the whole or any part of townships 24 and 25, range 27, west of the first meridian, now forming part of the Riding Mountain Forest Reserve. Presented 11th April, 1913.—*Mr. Oliver*..*Not printed.*

193. Return to an Order of the House of the 10th February, 1913, for a copy of all correspondence exchanged between the Department of Marine and Fisheries and the member for Temiscouata, and all other persons, respecting the placing of a light or line of lights on wharf at Ile Verte, County of Temiscouata. Presented 4th April, 1913.—*Mr. Paquet* ....*Not printed.*

194. Copy of a report of the Committee of the Privy Council, approved by His Excellency the Administrator, on the 5th April, 1913, relative to a contract for an ocean mail, passenger and freight steamship service between Canada and Great Britain and Great Britain and Canada, together with the articles of agreement for the said service. Presented by Hon. Mr. Pelletier, 7th April, 1913...........................*Not printed.*

195. Return to an Order of the House of the 10th March, 1913, for a statement showing the total volume of trade, in import and export, respectively, between Canada and Newfoundland for each year during the period from the 1st day of January, 1896, to the 1st day of January, 1913, and of what the said trade consisted of each year.

2. The volume of trade between Newfoundland and the West Indian Islands, included in the West Indian trade agreement with Canada, dated the 9th day of April, 1912, during the years 1909, 1910, 1911 and 1912, in import and export, and of what the said import and export consisted of each year. Presented 10th April, 1913.—*Mr. McKenzie.* *Not printed.*

195*a*. Supplementary return to an Order of the House of the 10th March, 1913, for a statement showing the total volume of trade, in import and export, respectively, between Canada and Newfoundland for each year during the period from the 1st day of January, 1896, to the 1st day of January, 1913, and of what the said trade consisted of each year.

CONTENTS OF VOLUME 28.—*Continued.*

2. The volume of trade between Newfoundland and the West Indian Islands, included in the West Indian trade agreement with Canada, dated the 9th day of April, 1912, during the years 1909, 1910 1911 and 1912, in import and export, and of what the said import and export consisted of each year. Presented 21st April, 1913.—*Mr. McKenzie* ....*Not printed.*

196. Return to an Order of the House of the 9th December, 1912, for a copy of all letters, telegrams, and correspondence referring in any way to the purchase or leasing of the property in Antigonish, N.S., now in use as a gun shed or store house for the equipment of the 18th Field Battery of Artillery. Presented 14th April, 1913.—*Mr. Chisholm (Antigonish)*.................. ....*Not printed.*

197. Return to an Order of the House of the 19th March, 1913, for a copy of all tenders asking for the construction of a drill hall at Fernie, B.C., of all correspondence concerning the awarding of the contract, and of all correspondence and documents regarding said tender and contract. Presented 14th April, 1913.—*Sir Wilfrid Laurier. Not printed.*

197*a*. Supplementary return to an Order of the House of the 19th March, 1913, for a copy of all tenders asking for the construction of a drill hall at Fernie, B.C., of all correspondence concerning the awarding of the contract, and of all correspondence and documents regarding said tender and contract. Presented 6th June, 1913. *Sir Wilfrid Laurier*.......................... ....*Not printed.*

198. Return to an Order of the House of the 24th February, 1913, for a copy of all correspondence and documents between the government of Canada or any officer thereof, and one Miss Mastin, of England, relating to a presentation of certain chinaware and other curiosities, made to the Government by the said Miss Mastin, in memory of the defeat at the polls of the agreement relating to reciprocity with the United States. Presented 14th April, 1913.—*Mr. Sinclair*..................................*Not printed.*

199. Return to an Order of the House of the 19th March, 1913, for a return showing the names, professions or occupations, residences, the date of appointment, and the salary in each case, of all correspondents of the *Labour Gazette*, and also the number of changes made in that particular for the year 1912. Presented 22nd April, 1913.—*Mr. Verville* ....*Not printed.*

200. Return to an Order of the House of the 26th March, 1913, for a return showing the amount of seed grain supplied to settlers in Peace River during the year 1912; the amount of seed grain being provided for settlers in Peace River during 1913; who distributed the seed grain supplied in 1912 and who is authorized to distribute seed grain in 1913; under what conditions seed grain was supplied during 1912, and those proposed for 1913; if provisions were supplied during 1912, what the conditions were and who gave out the supplies; if it is intended to supply provisions in 1913, what conditions will be given and who will give them out. Presented 25th April, 1913.—*Mr. Oliver* ....*Not printed.*

201. Return to an Order of the House of the 7th April, 1913, for a copy of all documents in the Department of the Interior prior to the issue of the Crown patents relating to Lot No. 217 of the Hudson Bay Company Survey, in the parish of St. John, Winnipeg. Presented 25th April, 1913.—*Mr. Proulx*..................................*Not printed.*

202. Return to an Order of the House of the 31st March, 1913, for a copy of all correspondence claims and reports with reference to compensation claimed by owners of horses attached to the 10th Field Battery at Camp Petawawa in the summer of 1912, by rea-

CONTENTS OF VOLUME 28.—*Continued.*

son of damage or disease contracted while in the service; also of all such claims paid, the amounts in each case, and the persons to whom paid. Presented 25th April, 1913.—*Mr. Carvell*...*Not printed*

203. Return to an Order of the House of the 11th December, 1912, for a copy of all papers, documents, pay-rolls, accounts, receipts, and correspondence in connection with all expenditures of money made in 1912 upon the Petite Rivière breakwater, Lunenburg County, Nova Scotia. Presented 29th April, 1913.—*Mr. Maclean (Halifax).* *Not printed.*

203a. Return to an Address to His Royal Highness the Governor General of the 9th December, 1912, for a copy of all advertisements tenders, contracts, orders in council, letters, correspondence, &c., relating to the construction of a wharf or breakwater at Seaforth, Halifax County, N.S. Presented 29th April, 1913.—*Mr. Maclean (Halifax).* *Not printed.*

203b. Return to an Order of the House of the 20th March, 1912, for a copy of all documents, letters, correspondence, petitions, reports, &c., addressed to the Department of Public Works since the 21st September last on the subject of a wharf now under construction at St. Croix, in the County of Lotbinière, province of Quebec. Presented 29th April, 1913.—*Mr. Fortier*...*Not printed.*

203c. Return to an Order of the House of the 19th March, 1913, for a return showing whether the repairs to Red Point wharf, Lot 48, Prince Edward Island, have been completed; if the work was done by tender or by day labour; if by tender, with whom the contract was made; if by day labour, the number of superintendents, inspectors, or overseers employed, their names, the number of days each did work, and the wages per day paid to each; the number of men employed, their names, the number of days each did work and the wages per day paid to each; who supplied the materials; the amount of each kind or class used, and the price paid for each kind or class; the total amount paid for materials, wages and cost of the work. Presented 2nd May, 1913.—*Mr. Hughes (Kings, P.E.I.)*...*Not printed.*

203d. Return to an Order of the House of the 31st March, 1913, for a copy of all documents, papers, correspondence, representations, &c., relating to the purchase of land at Digby, Nova Scotia, for the purpose of a site for a public wharf. Presented 2nd May, 1913.—*Mr. Maclean (Halifax)*...*Not printed.*

203e. Return to an Order of the House of the 19th March, 1913, for a return showing whether the repairs to Southport wharf, Lot 48, Prince Edward Island, have been completed; if the work was done by tender or by day labour; if by tender, with whom the contract was made; if by day labour, the number of superintendents, inspectors, or overseers employed, their names, the number of days each did work, and wages per day paid to each; the number of men employed, their names, the number of days each did work and the wages per day paid to each; who supplied the materials; the amount of each kind or class used and the price paid for each kind or class; the total amount paid for materials, wages and cost of the work. Presented 2nd May, 1913.—*Mr. Hughes (Kings, P.E.I.)*...*Not printed.*

203f. Return to an Order of the House of the 11th December, 1912, for a copy of all accounts, correspondence, telegrams, complaints and other documents in possession of the Department of Public Works, in relation to the expenditure of moneys on harbour improvements at Grand Etang, during the year 1911-12. Presented 13th May, 1913.—*Mr. Chisholm (Inverness)*.. .. ..*Not printed.*

CONTENTS OF VOLUME 28.—*Continued.*

203*g*. Return to an Order of the House of the 7th April, 1913, for a copy of all documents, correspondence, &c., relating to the purchase by the Department of Public Works of a certain quantity of timber for the construction of a wharf at St. Germain de Kamouraska, the said purchase having been made, as alleged, from Murray Castonguay during the year 1912. Presented 26th May, 1913.—*Mr. Lapointe (Kamouraska).* *Not printed.*

203*h*. Return to an Order of the House of the 29th January, 1913, for a copy of all letters written to the Honourable Minister of Public Works, or to any officer of the Public Works Department, or to any member of the government since 10th October, 1911, by G. A. R. Rowlings, John S. Wells and S. R. Griffin, relating to the construction of public works, County of Guysborough, N.S., also a copy of the replies to the same. Presented 29th May, 1913.—*Mr. Sinclair*......................................*Not printed.*

203*i*. Return to an Order of the House of the 7th May, 1913, for a copy of all correspondence exchanged between the Postmaster General and M. Isidore Belleau, of Quebec, in connection with improvements contemplated in Quebec harbour. Presented 2nd June, 1913.—*Mr. Carrell*..*Not printed.*

203*j*. Return to an Order of the House of the 28th April, 1913, for a copy of all papers, documents, pay-rolls, receipts, accounts, correspondence, &c., relating to repairs made upon the breakwater at Petite Rivière, Lunenburg County, N.S., in the year 1912. Presented 6th June, 1913.—*Mr. Maclean (Halifax)*........................*Not printed.*

204. Return to an Order of the House of the 4th March, 1912.—1. For a copy of all reports of engineers from 1874 to 1900, relating to the most suitable site in the harbour of Quebec for the construction of a dry dock.

2. Of all correspondence exchanged on the subject of a choice of a site for the dry dock now existing at St. Joseph de Lévis, at the time of its construction.

3. Of engineers reports, plans, maps and bearings relating to the construction of a new dry dock in the port of Quebec since 1900.

4. Of all correspondence exchanged between the different companies and the government relating to the construction of a new dry dock in the port of Quebec, since 1909.

5. Also for the production of all documents submitted by the different companies who have asked for the government grant provided by the Dry Dock Subsidies Act. Presented 29th April, 1913.—*Mr. Béland*...................................*Not printed.*

204*a*. Dry dock of Lévis. Report of Mr. Charles Smith against Sampson, et al.—(*Senate*). *Not printed.*

204*b*. Return to an Address to His Royal Highness the Governor General of the 19th March, 1913, for a copy of all orders in council, plans and estimates, correspondence, papers and inquiries respecting the construction of a dry dock at Quebec or Lévis or in the port or harbour of Quebec. Presented 6th June, 1913.—*Mr. Lachance*....*Not printed.*

205. Return to an Order of the House of the 9th April, 1913, for a copy of the petition of the Restigouche Fishermen's Association to the Minister of Marine and Fisheries asking for the removal of Mr. M. M. Mowat, head guardian of the Restigouche Riparian Association as Dominion fishery officer, and the answer thereto. Presented 2nd May, 1913.—*Mr. Marcil (Bonaventure)*...*Not printed.*

206. Return to an Order of the House of the 13th February, 1913, for a return showing the name of the company who has the contract for the electric lighting of the government buildings and grounds in Ottawa, date of contract and period, on what notice can contract be cancelled, price paid per kilowatt hour for electric lighting, names of

CONTENTS OF VOLUME 28.—*Continued.*

buildings lighted, cost of lighting each per year, rate for electric lighting if a combined power and light rate, price for current for power purposes, if lamps are not free, price paid for the carbon and tungsten lamps renewed, are lamps marked so as to be identified as belonging to the government buildings, number of electric lamp renewals paid for during the last fiscal year, where required, number of carbon and tungsten lamps respectively in use in the several buildings and the candle power or wattage of the same. Presented 2nd May, 1913.—*Mr. Wilson (Wentworth)*
Not printed.

207. Return to an Order of the House of the 17th February, 1913, for a copy of all correspondence, letters, telegrams, petitions, memoranda, reports, tenders, deposits, recommendations and all other documents of any nature whatsoever bearing on or having relation to the erection of a public building in the city of Three Rivers, P.Q., since the 11th day of October, 1911, to date. Presented 2nd May, 1913.—*Mr. Bureau.*
Not printed.

207a. Return to an Order of the House of the 26th May, 1913, for a copy of all papers, letters, and documents relating to the construction of a public building in the town of Laurentides, County of L'Assomption. Presented 4th June, 1913.—*Mr. Seguin.*
Not printed.

207b. Return to an Order of the House of the 2nd April, 1913, for a copy of all correspondence, letters, telegrams, contracts, tenders and reports of government inspector, in relation to the work and repairs on the public building at North Sydney during the year 1912, and particularly the inspector's report on the damages caused by fire during the construction of said works and repairs; and also a copy of the tenders of Henry Lovell, for the above work. Presented 6th June, 1913.—*Mr. McKenzie.*
Not printed.

207c. Return to an Order of the House of the 27th January, 1913, for a copy of all telegrams, letters, documents and plans relative to the purchase or acquirement of land for the purpose of erecting a public building in Stellarton, Nova Scotia, in the year 1912. Presented 6th June, 1913.—*Mr. Macdonald*................................*Not printed.*

208. Return to an Order of the House of the 24th February, 1913, for a return showing the names of the buildings occupied by the Government as public offices, which are under rent, excepting the Centre, East, West and Langevin Blocks; the street on which each of these offices is situated and the number of the street in each case. Presented 2nd May, 1913.—*Mr. Boulay*..*Not printed.*

209. Return to an Order of the House of the 11th December, 1912, for a copy of all accounts, correspondence, telegrams, complaints and other documents in possession of the Department of Public Works, relating to the construction of telegraph lines during the year 1911-12, from South West Margaree to Scotsville, from Scotsville to North Ainslee; from Scotsville to South Lake Ainslee and Whycocomagh; from Little Narrows to Whycocomagh; from Rossville to Big Intervale and from Rossville to the Victoria County Boundary Line, all in the County of Inverness. Presented 2nd May, 1913.—*Mr. Chisholm (Inverness)*...*Not printed.*

210. Correspondence in connection with the area or areas prescribed for mange in British Columbia.—(*Senate*).... ....*Not printed.*

211. Report made by the Central Railway of Canada to the Railway Department.—(*Senate*).
Not printed.

CONTENTS OF VOLUME 28.—*Continued.*

212. Return to an Address to His Royal Highness the Governor General of the 10th February, 1913, for a copy of all orders in council, letters, telegrams and of all other official documents of any kind in the possession of the Department of Customs, relating to the seizures of twenty horses from John Gobel, for smuggling them across the United States boundary near Coutts, or Writing-on-Stone, between the 20th and 28th of February, 1911. Presented 5th May, 1913.—*Mr. MacNutt*..............*Not printed.*

213. Return to an Address to His Royal Highness the Governor General of the 10th February, 1913, for a copy of all orders in council, letters, telegrams and of all other official documents of any kind in the possession of the Department of the Interior, relating to sale of school lands which have been held in the provinces of Alberta and Saskatchewan since the 12th day of October, 1911. Presented 7th May, 1913.—*Mr. McCraney*............ ....*Not printed.*

213*a*. Return to an Order of the House of the 2nd April, 1913, for a return showing by quarter-section, or fraction of quarter-section, all school lands sold in Manitoba, Saskatchewan and Alberta during the calendar year 1912; the price per acre at which each separate parcel was sold; the name and address of each purchaser; a list of all school lands sold at above sales which have since been cancelled; the price at which each parcel of said cancelled lands were sold, with the names and addresses of purchasers of each parcel of said lands sold and subsequently cancelled. Presented 23rd May, 1913.—*Mr. Turriff*........................... ....*Not printed.*

213*b*. Return to an Order of the House of the 12th February, 1913, for a return showing all school lands sold in the province of Saskatchewan in 1912, giving each parcel of land sold, the name and address of each purchaser, the date and place of sale, the name of the auctioneer at each sale, and any assignments of contracts of purchase of which the government has notice, and a copy of all correspondence passing between the Government, or any member thereof, and the Government of the province of Saskatchewan or any member thereof, with respect to the sale of school lands in the said province. Presented 6th June, 1913.—*Mr. Martin (Regina)*...........................*Not printed.*

214. Return to an Order of the House of the 9th April, 1913, for a copy of all petitions, affidavits, specifications, plans, drawings, claims, certificates, papers and patent rights in the Department of Agriculture or the Patents Branch thereof, with respect to Patent Number 142823. Presented 7th May, 1913.—*Mr. Carvell*............*Not printed.*

215. Return to an Order of the House of the 28th April, 1913, for a copy of all memorials, petitions, and letters, addressed to or sent by the Minister of Agriculture, or on his behalf, in connection with the establishment of an agricultural school, model farm or demonstration station at New Carlisle, Quebec. Presented 9th May, 1913.—*Mr. Marcil (Bonaventure)*................. ....*Not printed.*

216. Return to an Order of the House of the 28th April, 1913, for a copy of all telegrams, correspondence, returns, &c., between the Department of Agriculture, and any other person or persons, requesting recently that the Veterinary Director General of Canada visit Nova Scotia. Presented 9th May, 1913.—*Mr. Maclean (Halifax)*. *Not printed.*

217. Extent to which the Franking privilege is used by the several provinces in Canada for statistics.—(*Senate*)................. ....*Not printed.*

218. Return to an Order of the House of the 29th January, 1913, for a copy of all diaries and other documents relating to and showing the work performed during the months of June and July, 1912, by Homestead Inspectors Rathwell and Erratt in the Moosejaw land district. Presented 16th May, 1913.—*Mr. Knowles*....................*Not printed.*

CONTENTS OF VOLUME 28.—*Continued.*

218*a*. Return to an Order of the House of the 29th January, 1913, for a copy of all diaries relating to and showing the work performed during the months of June and July, 1912, by Homestead Inspectors Brandt, Balfour, Ouelette and Sipes, in the Regina land district. Presented 16th May, 1913.—*Mr. Martin (Regina)*........*Not printed*

218*b*. Return to an Order of the House of the 29th January, 1913, for a return showing the expenses of Homestead Inspectors Brandt, Balfour, Ouelette and Sipes during the months of June and July, 1912. Presented 16th May, 1913.—*Mr. Martin (Regina).* *Not printed.*

218*c*. Return to an Order of the House of the 29th January, 1913, for a return showing the expenses of Homestead Inspector Miller of the Moosejaw land district during the months of June and July, 1912, together with a copy of all reports, proceedings, diaries and other documents, showing the work performed during the said time by the said homestead inspector. Presented 16th May, 1913.—*Mr. Knowles*............*Not printed.*

218*d*. Return to an Order of the House of the 29th January, 1913, for a copy of all diaries and other documents relating to and showing the work performed during the months of June and July, 1912, by Homestead Inspectors Shields and McLaren, in the Swift Current lands district. Presented 23rd May, 1913.—*Mr. Knowles*........*Not printed.*

218*e*. Return to an Order of the House of the 29th January, 1913, for a return showing the expenses of Homestead Inspectors Shields, McLaren, Erratt and Rathwell, during the months of June and July of 1912. Presented 26th May, 1913.—*Mr. Knowles.* *Not printed.*

219. Return to an Order of the House of the 26th March, 1913, for a copy of all papers, memoranda, and instructions relating to a certain area of land on the bank of Little Manitou Lake, Saskatchewan, recently transferred to the town of Waterous, for park purposes. Presented 16th May, 1913.—*Mr. Oliver*..........................*Not printed.*

220. Return to an Order of the House, of the 4th December, 1912, for a copy of all correspondence and other documents in the possession of the Department of Public Works relating to the proposed interprovincial bridge between Hawkesbury, Ontario, and Grenville, Quebec. Presented 26th May, 1913.—*Mr. Proulx*................*Not printed.*

221. Return to an Order of the House of the 1st April, 1913, for a copy of all complaints, charges, evidence and reports in connection with the investigation held at Aldershot, N.S., in September, 1912, relating to the alleged thefts of property from the militia camp. Presented 26th May, 1913.—*Mr. Kyte*.............................*Not printed.*

221*a*. Return to an Order of the House of the 21st April, 1913, for a copy of all notices, tenders, contracts and correspondence relating to the supplying of ice for the military comp at Aldershot, N.S., for 1913, and of all correspondence relating to the source of such ice supply. Presented 26th May, 1913.—*Mr. Kyte*..................*Not printed.*

222. Return to an Order of the House of the 17th February, 1913, for a copy of all letters, proposals, tenders, memoranda, papers and documents in the possession of the Department of Trade and Commerce, or any department of the Government, bearing date since 1st December, 1912, relating to steamship service between Canada and the West Indies. Presented 27th May, 1913.—*Mr. Macleon (Halifax)*................*Not printed.*

222*a*. Return to an Order of the House of the 2nd April, 1913, for a copy of all correspondence, petitions, letters, telegrams, and other documents in the Department of Trade and Commerce, or any department of the Government, relating to the SS. service,

CONTENTS OF VOLUME 28.—*Continued.*

between Mulgrave, County of Guysborough and Cheticamp, Inverness County, during the years 1910-11, 1911-12, and 1912-13, and the service to be continued during the year 1913-14. Presented 27th May, 1913.—*Mr. Chisholm (Inverness)*............*Not printed.*

223. Return to an Order of the Senate calling upon the Clerk of the House to furnish a statement showing the number of Bills passed by the House of Commons since Confederation, which have been:—1. Amended by the Senate. 2. Rejected by the Senate. 3. Amended by the Senate and accepted by the Commons.—(*Senate*)......*Not printed.*

224. Return to an Order of the House of the 14th May, 1913, showing whether a contract was passed by the Post Office Department in the year 1911, for the use of stamp vending machines, the terms of said contract, the date, and by whom signed. Presented 2nd June, 1913.—*Mr. Lemieux*..*Not printed.*

225. Ordinances of the Yukon Territory, passed by the Yukon Council in the year 1913. Presented by Hon. Mr. Coderre, 2nd June, 1913..........................*Not printed.*

226. Names of judges of Superior and Circuit Court in province of Quebec, date of appointment, &c.—(*Senate*)..................... ....*Not printed.*

227. Return to an Order of the House of the 19th May, 1913, for a return showing the per capita taxation for the year ending 31st March, 1913, and for each of the twelve preceding years. Presented 3rd June, 1913—*Mr. Hughes (Kings, P.E.I.)*....*Not printed.*

228. Return to an Order of the House of the 29th May, 1913, for a return showing whether a certificate has been issued by the Treasury Board authorizing the transfer of the assets and liabilities of La Banque Internationale du Canada to the Home Bank; the terms of the said transfer, and all documents bearing on this question. Presented 3rd June, 1913.—*Mr. Lemieux*...................... ....*Not printed.*

229. Report of the Canadian delegates to the International Conference, held at New York for the consideration of the Commemoration of the First Century of Peace between the United States and the British Empire. Presented by Hon. Mr. Borden, 5th June, 1913............. ....*Not printed.*

230. Return to an Address to His Royal Highness the Governor General of the 10th March, 1913, for a copy of all correspondence, memoranda, orders in council, departmental orders and reports from fishery overseers or other officers, during the past two years, relating to weir licenses in the waters of the Counties of Charlotte and St. John, Province of New Brunswick. Presented 6th June, 1913.—*Mr. Pugsley*..........*Not printed.*

231. Return to an Order of the House of the 24th February, 1913, for a copy of all letters and papers relating to the issue of half-breed scrip, warrant No. 2155, certificate No. 672, to Albert St. Denis, and the disposition of the said scrip. Presented 6th June, 1913.—*Mr. Oliver*...................... ....*Not printed.*

232. Return to an Address to His Royal Highness the Governor General of the 3rd February, 1913, for a copy of all papers in connection with the withdrawal from settlement of a strip of land one mile in width along the line of the Hudson Bay Railway, and of the order in council, and also of all plans and correspondence in connection with the same, prior and subsequent thereto. Presented 6th June, 1913.—*Mr. Graham.* *Not printed.*

233. A return to an Order of the Senate dated 7th March, 1913, for a copy of all papers, letters, petitions, contracts and other papers relating in any way to the purchase of land at Le Pas for terminus of Hudson Bay road.—(*Senate*)............*Not printed.*

CANADA

COMPILED REPORTS

OF THE

INTERNATIONAL WATERWAYS COMMISSION

1905-1913

VOLUME II

Submitted in Accordance with the Provisions of Chapter 36, Section 37,
of the Revised Statutes of Canada.

PRINTED BY ORDER OF PARLIAMENT

OTTAWA
PRINTED BY C. H. PARMALEE, PRINTER TO THE KING'S MOST
EXCELLENT MAJESTY
1913

1908-9

THE INTERNATIONAL BOUNDARY ON THE GREAT LAKES AND CONNECTING WATERS

JOINT REPORT OF THE INTERNATIONAL WATERWAYS COMMISSION.

TORONTO, ONTARIO, June 23, 1908.

To the Honourable the Secretary of State of the United States of America and
The Honourable the Minister of Public Works of the Dominion of Canada.

The International Waterways Commission has the honour to submit the following report and preliminary estimate upon the work prescribed to it by article 4 of the Treaty of April 11, 1908, relating to the more complete definition and demarcation of the international boundary between the United States and the Dominion of Canada.

1. The commission has decided that the series of charts be uniform in size.

That a scale of 1 20,000 be adopted for the delineation of the rivers and Pigeon bay; that the head of the St. Lawrence river and foot of Lake Ontario, the east and west ends of Lake Erie, Lake St. Clair, False Detour passage and the east end of Lake Superior (Whitefish bay) be delineated on a scale of 1 60,000; that lakes Ontario, Erie, Huron and Superior be delineated on a scale of 1 300,000; and that the Niagara river from Lewiston to La Salle, and the St. Marys river from Little Rapids to Point aux Pins, be also delineated on a larger scale of 1 10,000.

The standard size of these charts to be 40 by 50 inches within the border.

Based upon the foregoing, there will be required:—

7 charts for the St. Lawrence river.
2 " " Lake Ontario.
2 " " Niagara river.
3 " " Lake Erie.
2 " " Detroit river.
1 chart " Lake St. Clair.
2 charts " the St. Clair river.
2 " " Lake Huron.
4 " " St. Marys river.
3 " " Lake Superior.
1 chart on 1 10,000 for Niagara falls.
a chart on 1 10,000 for St. Marys falls.

Total 30

That these charts be projected upon the new United States standard datum, and show substantially the following:—

The shore line of the lakes, rivers, islands and the mouths of the more important tributary streams; the location of all the principal cities and towns; the location of all lighthouses, and all permanent aids to navigation; and all of the hydrography available from the Canadian and United States surveys; all of the geographic positions upon which the projections are based; the boundary line, and all monuments, ranges, buoys, &c., used to mark it.

Our reasons for the foregoing recommendations are based upon a careful study of the Lake Survey charts. It was found that a series of charts based upon two scales, one for the lakes and one for the rivers, would not satisfy all of the conditions. Three scales, namely, 20, 60 and 300 thousand, cover every feature of the boundary in a fairly satisfactory manner, with the possible exception of the immediate localities of Niagara falls and the St. Marys falls. For these localities, where large power interests are located, we have adopted a chart for each on a scale of 1 10,000. It is possible that there may be other localities where, after further consideration, it may be advisable to delineate them on a scale of 1 10,000 also. It should be understood that these charts on this scale are to be extras; that is, they will cover areas that will be delineated on the smaller scale charts. It will be seen at a glance that this method would be much cheaper than to produce all of the river charts on a scale of 1 10,000.

One of the difficulties of producing all of the river charts on a scale of 1 10,000 is that in certain localities they would not show enough of the territory adjacent to the river to permit of showing permanent marks and ranges.

2. Having, as above, determined upon the most suitable scales for the proposed charts, there naturally follows the question of production, not only for delineating the boundary line, but for fulfilling the terms of the treaty by making four copies for the files of the two governments.

For the charts, the commission is of the opinion that the surveys of the United States Lake Survey can be safely taken, as they embrace all the United States shores and much of the Canadian, and that most of the missing portions of the latter can be filled in from the work of the Canadian Hydrographic Survey.

The majority of the charts of the United States Lake Survey now in use were constructed prior to the connection between its triangulation and that of the Coast and Geodetic Survey, from which was derived the United States standard datum, and as a consequence these charts are not in accord with that datum.

In our opinion it would be quite improper for an international commission engaged in such an important work as the delineation of a boundary line, to offer the public of two countries any charts not drawn from the latest information available.

It therefore becomes necessary to construct new charts for the special purpose upon nearly uniform scales.

The charts called for may be produced in three ways:—

(*a*) By draughting on paper;
(*b*) By photolithography, and
(*c*) By engraving.

(*a*) *By draughting.*—In this method, the projection, reduction and drawing must be drawn carefully on paper, and from the finished sheet, four separate copies would be taken singly and independently. This process would be very laborious and costly, and would leave infinite chances for inaccuracies, inconsistencies and omissions, to such an extent that it would be almost impossible to assert that any two copies were exactly alike. In addition, most of the accuracy obtained from redrawing would be sacrified in the various necessary transfers.

(*b*) *By photolithography.*—In this method one copy must be most carefully and neatly drawn in every particular for the photographer. The commission does not feel that it would be justified in adopting this method because of the distortion that usually accompanies the use of photography.

(*c*) *By engraving.*—There are two kinds of engraving usually practised in the production of charts, that upon stone and that upon copper, the former being cheaper and more expeditious.

In this process the projection can be accurately drawn upon the stones, and the details of shore-line, hydrography, &c., placed directly there by reducing from the originals either by pantagraph or photography without any necessity for a finished drawing. The commission has adopted this method of reproduction, because upon the stone the chart can be drawn more accurately than upon paper, and from this *any number* of charts can be printed immediately, each one exactly like all the others. In addition, if thought advisable, the charts can be preserved on these stones for all time; or they can be transferred to copper by the process now used by the Lake Survey, the copper plates preserved and the stones sold.

An approximate estimate of the chart work by this method would be $60,000.

3. Field work required for the preparation of charts.

In the construction of charts for navigation purposes the two governments have been engaged for several years. The survey of the United States shores has been completed in conjunction with a primary triangulation that extends into Canada in many places. Of the Canadian shores, those of lakes Huron and Erie have been completed, while that of Lake Superior is partially done, and, wherever possible, connection has been made with the triangulation of the United States Lake Survey, so that the two surveys may be taken as giving an accurate delineation of the outline of the lakes. For an accurate determination of the boundary line there remains to be surveyed the whole of the north shore of Lake Ontario from False Ducks to Port Dalhousie, a portion of Lake Superior in the vicinity of Otter Head, and a resurvey of Pigeon bay on a larger scale than has been used by the Canadian Hydrographic Survey.

4. Placing monuments, ranges, buoys, &c., to mark the boundary.

The treaty calls upon the commission to mark the international boundary by monuments, ranges, buoys, &c., wherever possible. The cost of this work will depend upon the number and character of marks established, but a rough estimate would be $100,000, making an approximate total for doing the work of $160,000.

A probable estimate for expenditures the first year is $15,000 for each government.

All of which is respectfully submitted.

GEO. C. GIBBONS,
Chairman, Canadian Section.

LOUIS COSTE,
Member, Canadian Section.

WM. J. STEWART,
Member, Canadian Section.

O. H. ERNST,
Brigadier-General U.S. Army, Retired.
Chairman, American Section.

GEORGE CLINTON,
Member, American Section.

E. E. HASKELL,
Member, American Section.

Attests—

THOMAS COTE,
Secretary, Canadian Section.

W. EDWARD WILSON,
Secretary, American Section.

FOURTH PROGRESS REPORT OF THE AMERICAN SECTION

Being Reports to the Secretary of State and the Secretary of War.

DECEMBER 1, 1908

REPORT TO THE SECRETARY OF STATE.

International Waterways Commission,
Office of American Section, 328 Federal Building,
Buffalo, N.Y., November 21, 1908.

The Honourable Secretary of State,
Washington, D.C.

Sir: 1. The American members of the International Waterways Commission have the honour to submit the following report covering their work under the Department of State during the year ending December 1, 1908.

2. By Article IV of the treaty between the United States and Great Britain signed April 11, 1908, and, after exchange of ratifications, proclaimed July 1, 1908, the commission is authorized to ascertain and re-establish the location of that portion of the international boundary between the United States and the Dominion of Canada which passes through the Great Lakes system beginning at its point of intersection with the St. Lawrence River near the forty-fifth parallel of latitude, and extending through the St. Lawrence River and the Great Lakes and communicating waterways to the mouth of Pigeon River, at the western shore of Lake Superior. A copy of this article of the treaty having been transmitted to the commission by your letter of May 21, 1908—copy appended marked 'A'—the subject was considered at meetings held in Buffalo June 2 and in Toronto June 23, and at the latter meeting a preliminary report, submitting a project for the work with estimate of cost, was prepared and forwarded, copy appended marked 'B.' After a careful study of existing charts it was concluded that the best results could not be obtained without constructing a new set of special charts. In view of the high standard of the existing charts, it is proper to state the reasons for this. The charts of the United States Lake Survey, as published, represent the highest type of surveying skill. The area covered by any single sheet is shown probably with as much accuracy as can be attained or is desired. The position of such area upon the earth's surface has, however, of late years been the subject of revision. The geographical coordinates used in constructing the charts were ascertained with the greatest precision obtainable at the time. Since that date, however, the telegraphic method of determining

longitude has become available for this territory to a much greater extent than it was then, and the triangulation of the Lake Survey has been connected with that of the Coast and Goedetic Survey. From this connection was derived the United States standard datum, to which all the more recent charts are referred. It shows that considerable corrections are required, to give the older charts their proper places on the earth's surface. Admirably as these charts have served and still serve their purpose, which is to aid navigation, they are not scientifically and theoretically correct. As the length of the line to be marked is over 1,300 miles, it is desirable that all known errors be eliminated. The scales of these charts, which vary considerably, are not the most convenient for the present purpose, while the size of the sheets is not uniform. They contain an immense amount of detail which is of no use in connection with the boundary and serves only to obscure it. New work in the field is required to delineate the Canadian shores of Lake Ontario and part of Lake Superior, which work is now in progress and will be completed by the Canadian Hydrographic Survey.

3. For these reasons the preparation of a set of special charts has, with your approval, been undertaken in the office of the American Section at Buffalo, under the joint supervision of the commission. They are to be of the uniform size of 40 by 50 inches within the border. The scale adopted for the delineation of the rivers and Pigeon Bay is $\frac{1}{20000}$; that for the head of the St. Lawrence River, the foot of Lake Ontario, the east and west ends of Lake Erie, Lake St.Clair, False Detour Passage, and the east end of Lake Superior is $\frac{1}{60000}$; that for Lakes Ontario, Erie, Huron,andSuperior $\frac{1}{300000}$; and for the immediate vicinity of Niagara Falls and the Sault Ste. Marie $\frac{1}{10000}$. The charts will show the shore lines of the lakes, rivers, islands, and the mouths of the more important streams; the location of all the principal cities and towns and of all the lighthouses and other permanent aids to navigation; all hydrography available from the Canadian and United States surveys; all the geographic positions upon which the projections are based; and the boundary line, with all monuments, ranges, buoys, etc., etc., used to mark it; unnecessary topography will be omitted. They will be projected and drawn directly upon copper plates, from which exact copies may be made in any desired number. Distortion of scale and errors in copying will thus be avoided. One set of copper plates having been prepared; a duplicate set will be made by electrotyping, and one set then deposited in the archives of each government. The data for these charts, with the exception of the new field work on the Canadian shores above mentioned, are in the Engineer Bureau of the War Department, and in the office of the Canadian Hydrographic Survey. Under authority of the honourable Secretary of War, the Chief of Engineers,U.S. Army, has placed at the disposal of the commission the original large scale manuscript charts constructed in the office of the Lake Survey, and other records of his bureau. The prompt and cheerful manner in which he has answered all calls for information deserves and receives the thanks of the commission.

4. Through the courtesy of the honourable Secretary of the Treasury, additional rooms in the federal building at Buffalo were assigned for the use of the commission, and the necessary furniture provided, certain special articles being made to order from designs furnished by the commission. By your letter dated August 7, 1908, an allotment of $10,000 was made for carrying on the work until an additional appropriation can be obtained from Congress.

5. These preliminary arrangements have consumed much time and have only recently been completed. The services of competent experts for projecting the maps and engraving them on copper have been secured, and the work is now fairly inaugurated under promising circumstances.

6. The cost of the work is estimated to be for the preparation of charts $60,000, and for the placing of monuments, ranges, buoys, etc., $100,000, or $160,000 in all, which being equally divided, makes a charge of $80,000 to each

country. The amount required by the American section for the next fiscal year is $20,000 in addition to the amount already allotted, and should be made immediately available. It will suffice to complete the charts. The amount required to place the monuments, etc., will be asked for next year.

Very respectfully,

O. H. ERNST,
Brig.-Gen'l, U.S. Army, Retired,
Chairman, of American Section.

GEORGE CLINTON,
Member of American Section.

E. E. HASKELL,
Member of American Section.

Attest:
W. Edward Wilson,
Secretary of American Section.

APPENDIX A.

Department of State,
Washington, May 21, 1908.

Brig. Gen. O. H. Ernst, U. S. Army, Retired, chairman.
Mr. George Clinton, and Prof. E. E. Haskell,
United States members of the International Waterways Commission.

Gentlemen: I have to bring to your knowledge the provisions of Article IV of the treaty between the United States and Great Britain, signed at Washington, April 11, 1908, and approved by the Senate, May 4, 1908, providing for a more complete definition and demarcation of the international boundary between the United States and the Dominion of Canada, which article in full reads as follows:

'The high contracting parties agree that the existing International Waterways Commission, constituted by concurrent action of the United States and the Dominion of Canada and composed of three commissioners on the part of the United States and three commissioners on the part of the Dominion of Canada, is hereby authorized and empowered to ascertain and re-establish accurately the location of the international boundary line beginning at the point of its intersection with the St. Lawrence River near the forty-fifth parallel of north latitude, as determined under Articles I and VI of the treaty of August 9, 1842, between the United States and Great Britain, and thence through the Great Lakes and communicating waterways to the mouth of Pigeon River, at the western shore of Lake Superior, in accordance with the description of such line in Article II of the treaty of peace between the United States and Great Britain, dated September 3, 1783, and of a portion of such line in Article II of the treaty of August 9, 1842, aforesaid, and as described in the joint report dated June 18, 1822, of the commissioners appointed under Article VI of the treaty of December 24, 1814, between the United States and Great Britain, with respect to a portion of said line and as marked on charts prepared by them and filed with said report, and with respect to the remaining portion of said line as marked on the charts adopted as treaty charts of the boundary under the provisions of Article II of the treaty of 1842, above mentioned, with such deviation from said line, however, as may be required on account of the cession by Great Britain to the United States of the portion of Horse Shoe Reef in the Niagara River necessary for the lighthouse erected there by the United

States in accordance with the terms of the protocol of a conference held at the British Foreign Office December 9, 1850, between the representatives of the two governments and signed by them agreeing upon such cession; and it is agreed that wherever the boundary is shown on said charts by a curved line along the water the commissioners are authorized in their discretion to adopt, in place of such curved line, a series of connecting straight lines defined by distances and courses and following generally the course of such curved line, but conforming strictly to the description of the boundary in the existing treaty provisions, and the geographical co-ordinates of the turning points of such line shall be stated by said commissioners so as to conform to the system of latitudes and longitudes of the charts mentioned, below and the said commissioners shall, so far as practicable, mark the course of the entire boundary line located and defined as aforesaid, by buoys and monuments in the waterways and by permanent range marks established on the adjacent shores or islands, and by such other boundary marks and at such points as in the judgment of the commissioners it is desirable that the boundary should be so marked; and the line of the boundary defined and located as aforesaid shall be laid down by said commissioners on accurate modern charts prepared or adopted by them for that purpose, in quadruplicate sets, certified and signed by the commissioners, two duplicate originals of which shall be filed by them with each government; and the commissioners shall also prepare in duplicate and file with each government a joint report or reports describing in detail the course of said line and the range marks and buoys marking it, and the character and location of each boundary mark. The majority of the commissioners shall have power to render a decision.

'The line so defined and laid down shall be taken and deemed to be the international boundary as defined and established by treaty provisions and the proceedings thereunder as aforesaid from its intersection with the St. Lawrence River to the mouth of Pigeon River.'

In the performance of the duties which will devolve upon you under this article of the treaty, you will act under and report to the Department of State.

I am, gentlemen, your obedient servant

ELIHU ROOT.

APPENDIX B.

Report of the International Waterways Commission upon the re-demarcation of the Boundary line on the Great Lakes and Connecting Waters. (See page 673.)

REPORT TO THE SECRETARY OF WAR.

INTERNATIONAL WATERWAYS COMMISSION,
OFFICE OF CHAIRMAN, AMERICAN SECTION.
WASHINGTON, D.C., December 1, 1908.

The Honourable Secretary of War, Washington, D.C.

SIR: 1. The American members of the International Waterways Commission have the honour to submit the following progress report covering their work under the War Department for the year ending December 1, 1908.

NIAGARA FALLS AND RIVER.

2. In our last progress report reference was made to a resolution which had been passed by the Committee on Rivers and Harbours of the House of Representatives, referring to the commission for report a bill which the committee had under consideration, entitled 'A bill amending an act entitled "An

act for the control and regulation of the waters of Niagara River, for the preservation of Niagara Falls, and for other purposes,' approved June 29, 1906. The object of the bill was to authorize the diversion of water from the Niagara River at the Whirlpool Rapids, below the falls, by the Lower Niagara River Power and Water Supply Company. The subject was considered at a meeting of the American Section in Buffalo, February 24, 1908. At this meeting representatives of the Niagara Gorge Railroad Company, and its subsidiary company, the Niagara Gorge Power Company, who also had a bill before Congress to authorize the diversion of water at the Whirlpool Rapids, asked for a hearing. Although their bill had not been referred to the commission, and could not be considered by it at that time, we thought it best to grant the hearing after explaining the circumstances to the applicant, in order to be prepared to report upon the bill in case it should be referred to us subsequently. It was not, however, so referred. At a joint meeting of the commission in Buffalo, March 3, 1908, a report to the Rivers and Harbours Committee was agreed upon and forwarded, copies being sent also to the honourable Secretary of War and to the honourable Secretary of State. A copy of the report is hereto appended marked 'A.'

3. During the summer of 1908 the works of the Niagara Falls Power Company were shut down upon three occasions, the first on June 14, to enable the International Railway Company to inspect the foundation of the American abutment, of their steel arch bridge, and the others July 19 and August 1, for the purpose of making repairs to the tunnel. The commission having been notified in advance, through the courtesy of Mr. Edward A. Wickes, vice-president of the company, took advantage of the opportunity to observe the effect upon the river and the falls of the diversion or non-diversion of the considerable body of water used by that company. Its American secretary was directed to install water gauges at and above the falls, and to observe these gauges before, during, and after the shut down, and to make a careful inspection of the tunnel while empty, in its hydraulic capacity. A violent storm on Lake Erie masked the effects of the shut down of June 14, but interesting results were obtained from the observations of those of July 19 and August 1. Upon July 19 the plant of the other power company on the American side, the Niagara Falls Hydraulic Power and Manufacturing Company, also was almost completely shut down. The report of the secretary upon these observations is hereto appended, marked 'B.' The conclusion which he reaches is that the diversion of 8,000 cubic feet per second through these plants lowers the level of Niagara River at Grass Island, near the intake of the Niagara Falls Power Company, about 3¼ inches; near the Ontario intake on the Canadian side, about 1¼ inches; and at Prospect Point, the crest of the American fall, about four-tenths of an inch. These results are at first glance somewhat surprising. They show that of the water diverted on the American side a larger portion is drawn from water naturally tributary to the Canadian fall than has heretofore been estimated. In 1907 the United States Lake Survey determined that the relative amount of water flowing over the American fall was about 4·85 per cent of the total discharge of the river, the remainder going over the Horseshoe Fall, which was at variance with preconceived notions. It now appears that these proportions hold also, at least approximately, for the water drawn through the power intakes as now located on the American side. It is possible that further observations, if they could be made, would increase the amount of change here attributed to the diversion of 8,000 cubic feet per second. The gauge observations were taken from staff gauges, by observers employed for the occasion, and may perhaps not be entirely free from error. But they are close approximations. If the amount of change as here found be doubled it will still remain small, and the conclusion above drawn as to the source of the water will hold good.

INTERNATIONAL BOUNDARY.

4. On the 11th of April, 1908, a treaty between the United States and Great Britain was signed at Washington, providing for the more complete definition and demarcation of the international boundary between the United States and the Dominion of Canada. Ratifications were exchanged at Washington June 4, 1908, and the treaty was proclaimed July 1, 1908. By Article IV of this treaty this commission is authorized to ascertain and re-establish the location of that portion of the boundary line which passes through the Great Lakes system, beginning at its point of intersection with the St. Lawrence River near the forty-fifth parallel of latitude, and extending through the St. Lawrence River and the Great Lakes and communicating waterways to the mouth of Pigeon River, at the western shore of Lake Superior. For this duty the commission acts under and reports to the honourable Secretary of State.

POWER WORKS IN ST. LAWRENCE RIVER NEAR LONG SAULT ISLAND.

5. The legislation proposed in the Congress of the United States relating to the development of power in the St. Lawrence River near Long Sault Island, was considered by the commission in 1907, but action was deferred at the request of the prime minister of Canada, as stated in our last progress report. After the date of that report the matter was left in abeyance by the American members, to await the convenience of their Canadian colleagues, until the meeting of October 31, 1908, when it was again brought up, and it was decided to consider and if possible finally dispose of the matter at a meeting to be held in Toronto, November 20. Before the latter meeting was held, however, a letter dated November 15, 1908, was received from the Long Sault Development Company—which is the company interested in the development on the American side—stating that the St. Lawrence Power Company, Limited—which is the allied company interested in the development on the Canadian side—were engaged in further surveys and studies, and that it was not the intention of the first named company to introduce a bill into the United States Congress until the plans for the entire project were complete. This removes all urgency in the case, and makes unnecessary for the present a separate report by the American section. Considerable opposition to the scheme has been developed by the navigation interests of the St. Lawrence River. The investigation by the Canadian government not having been completed, and the urgency of the case having been removed, consideration of the subject was again deferred.

REGULATION OF LAKE ERIE.

6. A large amount of labour has been expended during the year upon the solution of this important problem, but it has not been entirely completed. It is hoped that a report upon the subject can be submitted at an early day.

Very respectfully,

O. H. ERNST,
Brigadier-General, U.S.A., Retired, Chairman of American Section.

GEORGE CLINTON,
Member of American Section.

E. E. HASKELL,
Member of American Section.

Attest:
W. EDWARD WILSON,
Secretary American Section.

APPENDIX A.

REPORT OF THE INTERNATIONAL WATERWAYS COMMISSION UPON THE DIVERSION OF WATER AT THE WHIRLPOOL RAPIDS BELOW THE FALLS IN NIAGARA RIVER.

INTERNATIONAL WATERWAYS COMMISSION, OFFICE OF AMERICAN SECTION.
BUFFALO, N.Y., March 3, 1908.

Hon. T. E. BURTON, Chairman Committee on Rivers and Harbours,
House of Representatives, Washington, D. C.

SIR,—In compliance with the request contained in your letter of the 19th instant the International Waterways Commission have the honour to submit the following remarks upon the bill H. R. 25546, Fifty-ninth Congress, second session, introduced in the House of Representatives February 8, 1907, and referred to the commission in May last. The bill authorizes the Lower Niagara River Power and Water Supply Company to divert water from the Niagara River below the Falls to an amount not exceeding 40,000 cubic feet per second.

In our report to the two governments dated May 3, 1906, we recommended that the total amount of water to be diverted from the Niagara River above the falls should not be allowed to exceed 64,500 cubic feet per second, of which 28,500 cubic feet, including 10,000 cubic feet for the Chicago Drainage Canal, was to be diverted on the American side and 36,000 cubic feet on the Canadian side. These numbers were fixed by the special conditions of the case, and are not to be taken as a guide in fixing the amount of water which may properly be diverted from the Niagara River elsewhere or in dividing it between the two countries. The preservation of the rapids of Niagara River above and below the whirlpool is in our judgment of nearly as great importance to the æsthetic education of the people as is the preservation of the falls themselves. In both cases their grandeur is dependent upon their volume. In this case it is not necessary, and in our judgment it is not expedient, to allow the diversion of an amount which shall in any sense be experimental. It is our opinion that about 40,000 cubic feet per second can be diverted without perceptible injury to the rapids, and that any amount greater than that will approach the danger line more and more nearly according to its volume. We therefore recommend that no more than 40,000 cubic feet be diverted on both sides of the river taken together.

The general rule which should govern the diversion of the water between the two countries is that each side should be entitled to one-half. In the absence of a treaty between the two governments to regulate the diversion of water from the Niagara River, Congress should not, in our judgment, dispose of more than half of the total; that is in this case, 20,000 cubic feet per second. If no other company is to be provided for, there seems to be no objection to the passage of the bill referred to us, after cutting down the quantity of water to be allowed to 20,000 cubic feet per second.

Very respectfully,

O. H. ERNST,
Brigadier-General, U. S. Army, Retired, Chairman American Section.

GEORGE CLINTON,
Member American Section.

E. E. HASKELL,
Member American Section.

GEO. C. GIBBONS,
Chairmrn Canadian Section.

WM. J. STEWART,
Member Canadian Section.

Attest:
W. EDWARD WILSON,
Member American Section.

APPENDIX B.

Buffalo, N.Y., September 12, 1908.

To the International Waterways Commission:

Sirs,—In compliance with the instructions given me at the meeting of the commission held at Buffalo, N.Y., June 2, 1908, to take observations and determine the effect on the river and falls of the diversion of water by the American power plants at Niagara Falls, I have the honour to report:

I. On the condition of the tunnel of the Niagara Falls Power Company.

II. The quantity of water required to generate one horse-power in power-houses 1 and 2 of the Niagara Falls Power Company.

III. The effect on the Niagara River and Falls, caused by the shutting off of water from the plants on the American side of the Niagara River.

I. CONDITION OF THE TUNNEL OF THE NIAGARA FALLS POWER COMPANY.

On June 14, 1908, the Niagara Falls Power Company closed down their plant, to allow the International Railway Company to inspect the American abutment of the steel arch bridge, which is located near the outlet of the Niagara Falls Power Company's tunnel, the railway company being of the opinion that the abutment might be undermined, due to erosion, caused by the discharge of water from the tunnel. This shutdown also gave the Niagara Falls Power Company an opportunity to inspect the general condition of its tunnel. Accordingly, at 1.30 A.M. of the above date, the Niagara Falls Power Company's plant was closed down and the tunnel drained. Shortly thereafter, General Manager, Philip P. Barton, Maj. Charles W. Kutz, Corps. of Engineers, U.S. Army, and the writer, made an inspection trip of the tunnel, entering through the power plants of the company, located on the north shore of the Niagara River, adjacent to the pool immediately above the rapids approaching the falls. The water used by this company is extracted from the river through a forebay and large intake, passed through the turbines of the separate power-houses, discharged into two separate wheel pits, and thence carried by separate tunnels therefrom, which intersect at a point about 6,874 feet from the portal of the tunnel, whence it is discharged into the lower river. The tunnel is 6,917 feet in length, from the north end of wheel pit No. 1 to the outlet, and 7,548 feet from the north end of wheel pit No. 2 to the outlet. It has an average height of 21 feet and 0·25 inch and a maximum width of 18 feet 10 inches, with a circular top of approximately 11 feet 2½ inches radius, and an invert at the bottom whose inverse side is about 11¼ inches. From the ogee at the outlet of the tunnel, which ends about 205 feet from the face of the portal of masonary, the slope of the tunnel to station 52+0 is 0·7 per cent; from station 52 to station 68+73·5—the intersection of the tunnels from wheel pit No. 1 and wheel pit No. 2—the slope is 0·4 per cent.

Power-house No. 1 began operation August 25, 1895, and power-house No. 2, October 31, 1902. During this period, with one exception, when a shutdown was made several years ago for the purpose of inspecting the tunnel, the quantity of water discharged has reached several thousand cubic feet per second, flowing with a velocity of 20 to 30 feet per second in the tunnel, which, at various times, has carried ice that was discharged through the ice spillway into the tunnel. The lining of the tunnel is made up of several courses of vitrified brick, set in joints of Portland cement mortar, the inside surface being made as smooth as possible. From wheel pit No. 1 to the mouth of the tunnel, the condition of the lining was excellent. No erosion was noticeable at any place, the inside of the tunnel being covered with a very thin, green slimy deposit. Opposite the outlet of the International Paper Company's tunnel, which intersects the main tunnel about two-thirds of the distance from the mouth, a slight pitting of the brick surface was noticed, which was said to have been caused by blasting in the paper mill tunnel during construction. It was stated by the general manager that this same condition was noticed several years before, during a prior shutdown. From the intersection of the tunnels from wheel pits Nos. 1 and 2 to wheel pit No. 2, the lining was broken in two places; one point, about 25 feet above the intersection of the two tunnels, and the other at the junction of the tunnel with wheel pit No. 2. The breaks in the tunnel lining occurred in the roof in both instances. In the first case, bricks had been torn out and dropped into the tunnel for a distance of about 25 feet. In the second break, the entire roof had been ripped out for a distance of 10 or 11 bents, occupying approximately 100 linear feet, the roof falling in large blocks, the largest of which contained about 2 cubic yards, the bricks and cement forming a solid monolith. An inspection of these blocks, which were still in the invert of the tunnel, showed that the break in the roof of the tunnel had occurred several years ago, as the exterior fractured surfaces were well waterworn. The breaks in the roof are attributed to the discharge, during the first winter that power-house No. 2 was in operation, of large blocks of ice through the ice chute into the tunnel, which was accompanied by a large unbroken sheet of water, in which air was entrailed, and carried into the tunnel. At short intervals, during this period, explosions occurred, which shook the windows in power-house No. 2. These explosions ceased after a buffer or gridiron of of steel rails was placed in the ice chute, whereby the ice and the sheet of water were broken and the entrailed air allowed to escape before reaching the tunnel.

The inspection of the American abutment of the steel-arch bridge showed some slight erosion to the concrete retaining wall that had been placed near the outlet of the tunnel when the bridge was built, and resulted in the International Railway Company constructing, between July 19 and July 28, 1908, an additional buffer, or concrete retaining wall, placed outside on the north end of the abutment, to prevent further erosion of the original retaining wall by the water discharged from the tunnel.

II. QUANTITY OF WATER REQUIRED TO GENERATE ONE ELECTRICAL HORSE-POWER IN POWER-HOUSES 1 AND 2 OF THE NIAGARA FALLS POWER COMPANY.

On page 7 of the report by Capt. Charles W. Kutz, Corps of Engineers, U.S. Army, dated October 5, 1905 (being a part of the report upon the existing water power situation at Niagara Falls, so far as concerns the diversion of water on the American side), the following extract is quoted from section 9:—

'As a result of more or less recent tests made by the engineers of the power company, it was determined that an average in the two power-houses of 0·101 cubic feet of water per second was required to develop one electrical horse-power at the switchboard. If this determination is correct, the development of 100,000 electrical horse-power, the nominal capacity of the plant, would require 10,100 cubic feet of water per second. This amount exceeds by 1,500 cubic feet the amount computed as necessary under the assumed efficiency of the turbines and theoretic effective heads quoted above.'

The nominal capacity of power plants 1 and 2 has been stated to be 100,000 horse-power, but up to date the maximum amount of electrical horse-power actually developed, measured at the switchboard, was 82,460, which occurred about 5.30 P.M., October 27, 1905. No current meter measurements of the total flow of water were made in the canal at this time, so that the only method of determining the quantity actually used depends upon the turbine rating curves of one wheel in each power-house.

That 100,000 horse-power has never been developed is due to the fact that the tunnel cannot discharge the quantity of water required to generate the power under existing conditions. The tunnel was originally designed to carry the water from the wheels at an average velocity of about 25½ feet per second. In order for the water to attain this velocity, head must be created in the wheel pits, which necessarily reduces the effective head under which the turbines operate, thus decreasing the efficiency of the plant.

On June 13, 1908, at 10 A.M., the Niagara Falls Power Company had a load on their two power plants of 77,920 electrical horse-power, measured at the switchboards. During this time, the United States Lake Survey made current meter measurements of the quantity of water actually being used by the power company to develop this quantity of power. The writer has also obtained from the company the load upon the individual generators, the head acting on the turbines and their rated efficiency for various outputs of power.

The hydraulic data and loads on the several turbines in power-houses Nos. 1 and 2, taken during this extremely heavy output on the above-mentioned date, have been reduced and are given in table No. 1.

TABLE No. 1.—Showing quantity of water required to generate 1 electrical horse-power, measured at switchboard, in power-houses Nos. 1 and 2 of the Niagara Falls Power Company at 10 A. M., June 13, 1908.

Unit.	Load, kilowatts.	Load, Electrical horse-power.	Elevation, head water.	Elevation, tail water.	Mean head on turbines.	Rated efficiency of turbines.	Quantity of water used, determined by—		Quantity of water required to generate electral horsepower, measured at switchboard.	
							Turbine rating.	Current meter measurement	Turbine rating.	Current meter measurement.
Power house No 1							*Sec. ft.*	*Sec. ft.*	*Sec. ft.*	*Sec. ft.*
1	2,880	3,860	560·0	419·8	135·4	52·9	474	....	·123	·128
2	2,880	3,860	560·4	420·5	135·4	52·9	474	....	·123	·128
3	3,080	4,130	560·4	421·7	135·4	55·6	483	....	·117	·122
4	....	....	560·4	422·8	....	....	....	....	....	....
5	3,600	4,830	560·4	423·8	135·4	62·0	506	....	·105	·110
6	2,760	3,700	560·4	424·4	135·4	51·3	469	....	·127	·132
7	2,720	3,650	560·3	424·7	135·3	50·8	467	....	·128	·133
8	2,680	3,590	560·3	425·0	135·3	50·01	466	....	·130	·135
9	....	....	560·4	425·3	....	....	....	....	....	....
10	3,200	4,290	560·4	425·7	134·7	57·1	491	....	·114	·119
Total	23,800	31,910	....	....	....	....	3,830	3,995	·120	·125
Power house No 2,										
11	3,560	4,770	560·6	423·9	136·7	71·5	429	....	·090	·094
12	3,720	4,990	560·6	423·9	136·7	72·9	441	....	·088	·092
13	3,460	4,640	560·6	423·9	136·7	79·7	422	....	·091	·095
14	3,600	4,830	560·6	424·0	136·6	71·9	433	....	·090	·094
15	3,500	4,690	560·6	424·0	136·6	71·0	426	....	·091	·095
16	3,560	4,770	560·6	424·0	136·6	71·5	430	....	·090	·094
17	....	....	560·6	423·6	....	....	....	....	....	....
18	3,320	4,450	560·6	423·2	137·4	69·5	410	....	·092	·096
19	3,220	4,320	560·6	422·8	137·8	68·5	403	....	·093	·097
20	3,300	4,420	560·6	422·3	138·3	69·2	406	....	·092	·096
21	3,080	4,130	560·6	421·9	138·7	67·4	389	....	·094	·098
Total	34,320	46,010	....	....	....	....	4,189	4,370	·091	·095
Grand total	58·120	77,920	....	....	....	....	8,019	8,365	....	....

A reduction made by the rating tables of the 2 turbines in power-houses 1 and 2 gives the quantity of water used by the 8 turbines in power-house No. 1 as 3,830 cubic feet per second, and by the 10 turbines in power-house No. 2 as 4,189 cubic feet per second, a total of 8,019 cubic feet. The quantity of water actually used, as measured by the United States Lake Survey, was 8,475 cubic feet per second, from which should be deducted 35 cubic feet per second as the quantity used in the exciter turbines, and about 75 cubic feet per second, the quantity of water used by the Niagara Falls Water Works Company (see page 7 of report on water-power situation at Niagara Falls, so far as concerns the diversion of water on the American side, section 11 and end of section 12), which leaves 8,365 cubic feet passing through the turbines. Assuming that the amount of water actually used by the turbines in power-houses 1 and 2 is proportional to the difference in the current meter measurement and the amount determined by the rating curve, we have $\frac{4,189 \text{ x } 8,365}{8,019} = 4,370$ cubic feet per second, the quantity of water actually used in the turbines in power-house No. 2, and $\frac{3,830 \text{ x } 8,475}{8,019} = 3,995$ cubic feet per second, the quantity of water actually used in the turbines in power-house No. 1, a difference of approximately 4 per cent between the discharge as computed by the turbine ratings and the discharge as actually measured. This table is one of many which could be computed to determine the actual quantity of water that could flow through the Niagara Falls Power Company's tunnel with varying amounts of power developed. The results given herein hold for this condition only and should not be taken as a definite ratio until further observations have been reduced.

The efficiency of the turbines decrease rapidly when they are operated on part load, and any determination of the quantity of water required to generate one electrical horse-power should be determined when the plant is operated at its full instead of part load. A determination made at part load gives a much larger quantity of water per horse-power than under full load, which if used to compute the capacity of the plant would be in considerable error. Table No. 1 shows that under the conditions at time of measurement a load of 4,800 horse-power on a generator in power-house No. 1 required 0·110 cubic feet per second per horse-power, whereas a load of 3,700 horse-power required 0·132 cubic foot per second per horse-power. In power-house No. 2, 5,000 horse-power required 0·092 cubic foot per second per horse-power, whereas 4,100 horse-power required about 0·098 cubic foot per second per horse-power. It is readily seen, therefore, that unless all of the turbines are loaded to their full capacity, which has not occurred to date, it will be very difficult to state the quantity of water in cubic feet per second required to generate one horse-power. Under the conditions existing at time of measurement, an average load of 4,000 horse-power per generator in power-house No. 1 required 0·125 cubic foot per second to generate one horse-power, measured at the switchboard; while an average load of 4,600 horse-power per generator in power-house No. 2 required 0·095 cubic foot per second to generate one horse-power.

III. THE EFFECT ON THE NIAGARA RIVER AND FALLS CAUSED BY THE SHUTTING OFF OF WATER FROM THE PLANTS ON THE AMERICAN SIDE OF NIAGARA RIVER.

Commencing at 7 A.M., June 13, 1908, the International Waterways Commission, in conjunction with the United States Lake Survey and the Niagara Falls Power Company, observed water levels at several points in the Niagara river, which are located as shown on plate 1. The gauges are numbered as follows: Gauge No. 1, South Pier, Buffalo Harbor, Buffalo, N.Y.; gauge No. 2, foot of Austin street, Buffalo, N.Y.; gauge No. 3, Chippewa Creek, Chippewa, Ontario; gauge No. 4, Grass Island, Niagara Falls, N.Y.; gauge No. 5, about 200 feet east of the intake of the Ontario Power Company's plant, Niagara Falls, Ontario; gauge No. 6, Willow Island, Niagara Falls, N.Y.; gauge No. 7, Prospect Point, crest of American falls, Niagara Falls, N.Y. These gauges were read at ten-minute intervals for the following periods:

June 13, 7 A.M., to June 16, 7 A.M.
July 18, 8 A.M., to July 20, 12 midnight.
June 27, 8 A.M., to July 29, 12 midnight.
August 1, 8 A.M., to August 3, 4 P.M.

The following is a record of the operations of the Niagara Falls Power Company's power plant and the Niagara Falls Hydraulic Power and Manufacturing Company's power plant during the period from June 13 to August 6, 1908, inclusive.

RECORD OF THE NIAGARA FALLS POWER COMPANY'S PLANT.

June 13, power-houses 1 and 2 in operation.

June 14, 1.30 A.M., power-houses 1 and 2 shut down.

June 14, 9 A.M., power-houses 1 and 2 in operation.

July 19, 1.30 A.M., power-houses 1 and 2 shut down.

July 19, 1.30 A.M., to July 28, 12.30 A.M., company constructed bulkhead in tunnel No. 2, at intersection of tunnels 1 and 2 with main tunnel.

July 28, 12.30 A.M., power-house No. 1 in operation.

July 28, 12.30 A.M., to August 1, 11.30 P.M., power-house No. 1 in operation, power-house No. 2 shut down. Company repairing tunnel leading to wheelpit No. 2.

August 1, 11.30 P.M., power-houses 1 and 2 shut down and company started to remove bulkhead.

August 2, 7.30 P.M., power-houses 1 and 2 in operation.

RECORD OF NIAGARA FALLS HYDRAULIC POWER AND MANUFACTURING COMPANY'S POWER PLANT.

June 13, plant in operation.

June 14, 6.30 A.M., entire plant closed, with exception of about 280 cubic feet per second in canal.

June 14, 9.30 A.M., power plant in operation.

July 19, 1 A.M., plant closed down to about 500 cubic feet per second.

July 19, 5 A.M., plant closed down to about 300 cubic feet per second.

July 19, 8 A.M., plant in operation.

The gauge readings show the stage of water at the several gauges and also the quantity of water diverted from the pool above the rapids approaching the falls, are shown on plates 2, 3, and 4. The gauge readings of June 13, 7 A.M., to June 16, 7 A.M., have not been plotted, owing to the fact that at the time of the shut down a severe storm occurred on Lake Erie, which raised its level about 2 feet and masked the effects of the diversion of water by the power companies on the pool above the falls and on the American falls. The amount of water diverted by the Niagara Falls Power Company was determined by current meter measurement, and that by the Niagara Falls Hydraulic Power and Manufacturing Company from results deduced by the company.

In determining the effect of this diversion of water, a comparison was made of the slope in the Niagara River from Buffalo, N.Y., to the several gauges at

Niagara Falls; first, under the condition when the plants were shut down; secondly, when they were in operation. The results of these changes are shown on Plate 5. In all cases the fall of the river from Buffalo to these gauges increased during the period that the power plants were in operation, which varied with the quantity of water being diverted from the pool.

Table No. 2 gives the absolute change in the fall from Buffalo to the several gauges, with the corresponding change in the amount of water diverted through these power plants:

TABLE No. 2.

Date.	Gauge.	Change in quantity of water diverted from river by American power plants.	Corresponding change in fall from Buffalo to the several gauges in Niagara River.
1908.		*Cubic feet per second.*	*Feet.*
July 18–19....	No. 3, Chippewa....	8,210	0·076
July 18–19....	No. 4, Grass Island....	8,210	·256
July 18–19....	No. 5, Ontario Intake....	8,210	·112
July 18–19....	No. 6, Willow Island....	8,210	·072
July 18–19....	No. 7, Prospect Point....	8,210	·044
July 27–28....	No. 3, Chippewa....	5,300	·012
July 27–28....	No. 4, Grass Island....	5,300	·168
July 27–28....	No. 5, Ontario Intake....	5,300	·059
July 27–28....	No. 6, Willow Island....	5,300	·037
July 27–28....	No. 7, Prospect Point....	5,300	·015
August 1–2...	No. 3, Chippewa....	6,380	·140
August 1–2...	No. 4, Grass Island....	6,380	·241
August 1–2...	No. 5, Ontario Intake....	6,380	·080
August 1–2...	No. 6, Willow Island....	6,380	·088
August 1–2...	No. 7, Prospect Point....	6,380	·022
August 2.....	No. 3, Chippewa....	5,890	·066
August 2.....	No. 4, Grass Island....	5,890	·210
August 2.....	No. 5, Ontario Intake....	5,890	·082
August 2.....	No. 6, Willow Island....	5,890	·061
August 2.....	No. 7, Prospect Point....	5,890	·025

The above results are represented graphically on Plate VI, which show the amounts that the water surface is lowered at the several gauges by the diversion of water through the American power plants from the pool above the rapids approaching the falls.

The maximum effect of the diversion occurred at gauge No. 4, Grass Island, located near the intake of the Niagara Falls Power Company. The fluctuations in gauge No. 3, located at Chippewa, Ontario, were, apparently, not consistent. The effects on the other gauges decreased in the following order: Gauge No. 5, Ontario intake; gauge No. 6, Willow Island; and gauge No. 7, Prospect Point, crest of American falls.

CONCLUSIONS.

The conclusions reached in the above report may be summarized as follows:

1. The tunnel of the Niagara Falls Power Company showed no apparent erosion from the friction of the water with the lining.

The breaks in the tunnel from wheel pit No. 2 to the intersection of tunnels Nos. 1 and 2 with main tunnel, were probably caused by ice with entrailed air, which was carried into the tunnel during the period of ice sluicing the first winter that power-house No. 2 was in operation.

An additional retaining wall, or buffer, was constructed to prevent further erosion of the original retaining wall which had been built for the protection of the American abutment of the steel arch bridge at Niagara Falls.

2. The maximum quantity of water required for a maximum load, in power-houses Nos. 1 and 2 of the Niagara Falls Power Company, to generate 1 electrical horse-power measured at the switchboard, is unknown until a complete investigation of the subject has been made, which is not within the scope of this report.

One hundred and twenty-five thousandths of a cubic foot of water per second per electrical horse-power, measured at the switchboard, was required on June 13, 1908, to develop an average load of 4,000 electrical horse-power on 8 generators in power-house No. 1 of the Niagara Falls Power Company.

Ninety-five thousandths of a cubic foot of water per second per electrical horse-power, measured at the switchboard, was required on June 13, 1908, to develop an average load of 4,600 electrical horse-power on 10 generators in power-house No. 2 of the Niagara Falls Power Company.

3. The surface of the Niagara River is lowered by the diversion of 8,000 cubic feet of water per second through the plant of the Niagara Falls Power Company and that of the Niagara Falls Hydraulic Power and Manufacturing Company by the following amounts:

	Foot.
Gauge No. 4, Grass Island, near intake of the Niagara Falls Power Co...	0·271
Gauge No. 5, near Ontario intake....................................	·104
Gauge No. 6, Willow Island..	·078
Gauge No. 7, Prospect Point, crest of American ialls....................	·031

4. In 1907 the United States Lake Survey determined that the relative amount of water flowing over the American falls was about 4·85 per cent of the total volume of the discharge of the river, the remainder going over the Horseshoe Falls.

The amount the water is lowered on the crest of the American falls when 8,000 cubic feet per second is being taken by the American power plants is, therefore ,small. When these plants are closed down, only approximately 5 per cent of this 8,000 passes over the American falls. This fact is substantiated by the nearly equal rise of 0·10 of a foot in the water surface at gauge No. 5, located near the Ontario intake on the Canadian side of the river, and that of 0·08 of a foot rise at gauge No. 6, located at Willow Island on the American side. These gauges are situated about equal distances from the crest of the rapids approaching the falls.

Very respectfully,

W. EDWARD WILSON,

Secretary American Section.

FIFTH PROGRESS REPORT OF THE AMERICAN SECTION.

DECEMBER 7, 1909.

Being reports to the Secretary of State and the Secretary of War.

REPORT TO THE SECRETARY OF STATE.

International Waterways Commission,
Office of Chairman, American Section,
Washington, D.C., December 7, 1909.

The Honourable Secretary of State,
Washington, D.C.

Sir,—The American members of the International Waterways Commission have the honour to submit the following report covering their work under the Department of State during the year ending December 1, 1909.

2. By Article IV of the treaty between the United States and Great Britain, signed April 11, 1908, the commission is authorized to ascertain and re-establish the location of that portion of the international boundary between the United States and the Dominion of Canada which passes through the Great Lakes system, beginning at its point of intersection with the St. Lawrence River near the forty-fifth parallel of latitude and extending through the St. Lawrence River and the Great Lakes and communicating waterways to the mouth of Pigeon River at the western shore of Lake Superior. To properly do this it was found necessary, for reasons given in our last progress report, to construct a series of new charts especially prepared for the purpose.

3. The construction of the new charts made good progress during the year. This work is being done in the Buffalo office of the commission by experts from Canada and the United States. There are to be constructed in all 30 charts, including an index chart, as follows, viz: Eighteen charts on a scale $\frac{1}{20000}$, to include 7 for the St. Lawrence River, 2 for the Niagara River, 2 for the Detroit River, 2 for the St. Clair River, 4 for the St. Marys River, and 1 for Pigeon Bay; 5 charts on a scale of $\frac{1}{60000}$, to include 1 each for the eastern end of Lake Ontario, the western end of Lake Erie, Lake St. Clair, northern end of Lake Huron, and eastern end of Lake Superior; 4 charts on a scale of $\frac{1}{300000}$, to include 1 each for Lake Ontario, Lake Erie, Lake Huron, and Lake Superior; 2 charts on a scale of $\frac{1}{10000}$, to include 1 each for Niagara Falls, and the Sault Ste. Marie; and 1 index chart on a scale of $\frac{1}{1200000}$. During the year 11 of the sheets mentioned above were reduced from the originals and turned over to the copper-plate engravers. Of this number 6 are river charts, scale $\frac{1}{20000}$; 2 are lake charts, scale $\frac{1}{60000}$; and 1 is a lake chart, scale $\frac{1}{300000}$. At the present time, 5 additional river charts are under construction by the

draughtsmen, upon 2 of which about 50 per cent of the work has been completed, the others being only fairly begun. The engraving upon the copperplates has been completed to the extent of 95 per cent for 2 charts, 80 per cent for 5 charts, 20 per cent for 2 charts, and 10 per cent for 1 chart.

4. It was found necessary to send parties into the field to secure additional data pertaining to several localities. A topographical survey was made on the west shore of the Detroit River between Trenton, Mich., and Pointe Mouillee, Mich. Positions of the permanent lights on the St. Clair River, not previously determined, were observed. A triangulation and topographic survey of Niagara River from Buffalo to Niagara Falls was begun in July and is now nearing completion. An American and a Canadian surveying party have been engaged upon this work. A Canadian party is also in the field taking topography from Sarnia, Ontario, near the head of the St. Clair River, to Cape Ipperwash, on Lake Huron.

5. As the greater part of the data upon which these charts are based is found in the records of the Engineer Bureau of the War Department, the commission has been constantly in correspondence with that bureau, and we desire to acknowledge the promptness and courtesy of the Chief of Engineers, Gen. W. L. Marshall, in answering all of its calls for information.

At a meeting of the commission held in Toronto on September 3, 1909, the question was considered of what amount of money it would recommend for appropriation to continue its work during the year ending June 30, 1911, and after discussion the following resolution was adopted, viz:

'Resolved, That the appropriation to be asked for by each section for the coming fiscal year for continuing the work required to ascertain, re-establish and mark the course on the ground of the international boundary line, be $30,000.'

A copy of this resolution was forwarded to you under date of October 9, 1909, with the recommendation that the sum of $30,000 for continuing the work referred to be included in the estimates of the department for the coming year.

Yours very respectfully,

O. H. ERNST,

Brig. Gen., U.S. Army, Retired,
Chairman of American Section.

GEORGE CLINTON,

Member of American Section.

E. E. HASKELL,

Member of American Section.

Attest:

W. Edward Wilson,

Secretary of American Section.

REPORT TO THE SECRETARY OF WAR.

International Waterways Commission,
Office of Chairman, American Section.
Washington, D. C., December 7, 1909.

The Honourable Secretary of War,
Washington, D. C.

Sir: 1. The American members of the International Waterways Commission have the honour to submit the following progress report covering their work under the War Department for the year ending December 1, 1909:

REGULATION OF LAKE ERIE.

2. The study of this subject was continued during the year. The mutual interdependence of the Great Lakes and their connecting channels is so close that a study of one is not complete without a study of all. The effect of an attempt to regulate Lake Erie cannot be fully ascertained without an hydraulic analysis of the general regulation of all the lakes. This analysis was a long and laborious undertaking, but it was practically completed early in 1909. It includes a large number of tables and plates, many of them of an elaborate character. A study of these documents led to the conclusion that it was not practicable to regulate the monthly mean level of Lake Erie within a range of 1 foot, as proposed by one of the boards of engineers which preceded this commission, but that it would be practicable to regulate it within a range of about 20 inches. A further study of the effect of such regulation led to the conclusion that while it would benefit the navigation of Lake Erie, Lake St. Clair, and Lakes Michigan-Huron, it would injure Lake Ontario and the St. Lawrence River, and the low-lying shores of Lake Erie, especially at Buffalo. If the advantages and disadvantages could be equally distributed among all the persons affected the former might outweigh the latter, but as a matter of fact those who navigate the St. Lawrence canals are not specially concerned with deepening the harbours of Lake Erie, nor are those who occupy the low-lying portions of Buffalo and other places sufficiently compensated for the injury to their property by the beneficial effects upon navigation. Questions of a peculiarly intricate character would arise of damages to vested rights. It seemed to the commission that the advantages to be derived from this regulation were not of such overwhelming character as to justify the two governments in raising these vexatious questions.

3. By the term 'regulation' as here employed is meant the most complete practicable regulation, such as can be secured by a dam and sluice gates located at or near Buffalo. While it may be inexpedient to construct such works, it does not follow that nothing can be done to improve or maintain the level of the lakes. It is possible to raise the level of any lake by simply reducing the size of its outlet. With a reduced cross section the outlet requires a steeper slope, and the average level of the lake is raised, but the oscillations will go on as before, and the discharge will remain the same. To raise the level of Lake Erie will raise also, but to a less degree, the levels of Lake St. Clair and of Michigan-Huron, and will thus benefit those waters, while it will have no effect on Lake Ontario or the St. Lawrence River. It is believed that somewhere in the Niagara River between Lake Erie and the Falls, a submerged dam may be placed which will greatly benefit the navigation of the waters above, without injury to those below, and with only minor damages, if any, to the adjoining land. The upper river is a valuable safety valve for the protection of Buffalo

in time of storms upon Lake Erie and should not be obstructed by a dam. It is possible that the extreme lower end of the reach, that is, the section just above the falls, may not be available, because of excessive overflow to be caused in the valley of the Welland River. To determine the best site it has been necessary to make additional surveys. These were begun in July, 1909, and are still in progress.

DETROIT RIVER IMPROVEMENT.

4. On the 2nd of June, 1909, a letter was addressed to Lieut. Col. C. McD. Townsend, Corps of Engineers, U. S. Army, the officer in charge of the channel improvements in the Detroit River, by Mr. H. J. Lamb, Engineer in Charge, Department of Public Works, Canada, inquiring by what authority the United States was depositing material in Canadian waters in the construction of the Livingstone Channel, Detroit River. This letter was forwarded by Lieutenant-Colonel Townsend, with his letter of June 3, to the Chief of Engineers, and by request of the latter was referred to the International Waterways Commission by the Acting Secretary of War, by indorsement dated June 16, 1909. At its meeting in Buffalo, July 14, 1909, the commission adopted the following resolution, viz:

'Whereas the enlargement of the navigable channel in the Detroit River, now being made by the United States Government, west of Bois Blanc Island, is of great benefit to the navigation interests of Canada, as well as of the United States; and

'Whereas the excavations for said channel and the dumping grounds are partly in Canadian waters; and

'Whereas the consent of the Canadian Government to such use of its waters has not been given;

'*Resolved*, That in the opinion of the commission application should be made without delay to the Canadian Government by the United States Government for formal permission to excavate the channel where that work is now progressing, and that such application, when received by the Canadian Government, should be granted, provision being made that the dumping grounds in Canadian waters should be located under the direction of the Minister of Public Works of Canada.'

The matter was then brought to the attention of the Department of State, and by that department to the attention of His Excellency the British Ambassador at Washington. The desired permission was granted by the Canadian Government upon the condition named in the resolution that 'the dumping grounds in Canadian waters be located under the direction of the Minister of Public Works of Canada', and with the proviso 'that such permission is given without prejudice to the possessory rights of Canada as defined by the maps and declarations of the commissioners under the treaty of Ghent, made at Utica on the 19th of June 1822, and provided also that the dumping of material should not prove in any way a detriment to the safe navigation of the Detroit River.' Notice of this action was sent to the Department of State by the British Ambassador in his letter of September 17, 1909. The correspondence in this case will be found in Appendix 'A.'

CEDARS RAPIDS, ST. LAWRENCE RIVER.

5. On the 18th of December, 1908, the secretary of the Department of Public Works of Canada referred to the commission an application of the Cedars Rapids Manufacturing and Power Company to the Canadian government for permission to build works in the St. Lawrence River at Cedars, in the county of Soulanges, for the purpose of developing electric power. At this place both

banks of the St. Lawrence River are Canadian territory, but power works in the bed of the stream affect the navigation interests of the entire river. On the 13th of April, 1909, the commission submitted a report upon the subject to the Minister of Public Works of Canada, of which copies were furnished to the Secretary of State, and the Secretary of War, of the United States. A copy of this report is hereto appended, marked 'B.'

LONG SAULT RAPIDS ST. LAWRENCE RIVER.

6. The legislation proposed in the Congress of the United States in 1907, relating to the development of power in the St. Lawrence River, near Long Sault Island, was considered by the commission in 1907, but action was deferred at the request of the Prime Minister of Canada, as stated in former reports. It was again considered in 1908, but it was found that the plans of the projecting company were undergoing modification, and that the investigation of the subject undertaken by the Canadian government had not been completed. The situation remains unaltered. The perfected plans have not been presented to the commission, and the Canadian Government has not signified its wish to have the commission consider the matter.

Very respectfully,

O. H.ERNST,
Brig. Gen., U.S. Army, Retired,
Chairman of American Section.

GEORGE CLINTON,
Member of American Section.

E. E. HASKELL,
Member of American Section.

Attest:
W. EDWARD WILSON,
Secretary of American Section.

APPENDIX A.

WAR DEPARTMENT,
UNITED STATES ENGINEER OFFICE,
DETROIT, MICH., JONES BUILDING, June 3, 1909.

Mr. H. J. LAMB,
Engineer in charge,
Department of Public Works, Canada, London Ontario.

DEAR SIR,—I have the honour to acknowledge the receipt of your letter of the 2nd instant, in reference to the work now in progress on the Livingstone Channel.

When you called my attention to the matter I was surprised to find no record in this office that the Canadian Government had been consulted before work of such magnitude had been commenced by the United States Government in waters which are a subject of dispute between the two countries.

While a report of the Committee of the Honorable the Privy Council approved by the Administrator on the 8th August, 1893, would appear to permit excavation by the United States at the Lime Kiln Crossing, this office by no means construes this authority as permitting it to deposit material in Canadian waters, and I shall recommend the removal of any material by the United States that has been or may hereafter be deposited in any waters claimed by the Canadian government, upon its presenting any objection.

As I informed you in our interview, there are, however, involved in the construction of this channel questions of vital importance to the navigation of the Great Lakes which are being considered by a board of engineers recently convened. This board will submit a report at an early date, which may contain recommendations which will materially affect the entire question at issue, and I have therefore to suggest that action in the matter be deferred until this board can submit its report to the authorities at Washington.

The attention of the Chief of Engineers has been invited to the questions propounded by you, and the suggestion submitted that the joint approval of both governments should be secured before final action is taken.

Very respectfully,

C. McD. TOWNSEND,

Lieut. Colonel, Corps of Engineers, U.S. Army.

WAR DEPARTMENT, UNITED STATES ENGINEER OFFICE,

DETROIT, MICH., JONES BUILDING, June 3, 1909.

The Chief of Engineers, U.S. Army,
Washington, D.C.

SIR,—The Canadian Government, through its engineers, has made inquiry by what authority the United States is depositing material in Canadian waters in the construction of the Livingstone Channel, Detroit River. The boundary line between the United States and Canada is not clearly defined, and the Livingstone Channel occupies a location where it is difficult to state what portion is in American and what in Canadian waters.

The definite determination of the boundary line it is believed is at present being determined by an international commission, and while there is some question as to whether the rock now being excavated is not in American waters, I consider it probable that some portions of the cofferdam are on the Canadian side of the boundary, and therefore believe it impolitic for this office to attempt to determine the line. I have therefore addressed to the engineer in charge of the Canadian works in Ontario a letter, a copy of which is inclosed, and have to recommend before final action on the Livingstone Channel is taken, the Canadian Government be consulted.

Very respectfully, your obedient servant,

C. McD. TOWNSEND,

Lieut. Colonel, Corps of Engineers.

[First indorsement.]

WAR DEPARTMENT, OFFICE OF THE CHIEF OF ENGINEERS,

WASHINGTON, June 16, 1909.

Respectfully submitted to the Secretary of War with recommendation that these papers be transmitted to the International Waterways Commission for consideration and remark.

W. L. MARSHALL,

Chief of Engineers, U.S. Army.

[Second indorsement.]

WAR DEPARTMENT, June 16, 1909.

Respectfully referred to the International Waterways Commission, Room 606, Westory Building, Washington, D.C., requesting action in accordance with the recommendation of the Chief of Engineers in preceding indorsement.

ROBERT SHAW OLIVER,
Assistant Secretary of War.

[Third indorsement.]

INTERNATIONAL WATERWAYS COMMISSION,
OFFICE OF CHAIRMAN, AMERICAN SECTION.
WASHINGTON, D. C., July 15, 1909.

Respectfully returned to the Honourable Secretary of War.

This paper was laid before the International Waterways Commission at its meeting in Buffalo yesterday, whereupon the commission passed the following resolution:

'Whereas the enlargement of the navigable channel in the Detroit River, now being made by the United States Government, west of Bois Blanc Island, is of great benefit to the navigation interests of Canada, as well as of the United States; and

'Whereas the excavations for said channel and the dumping grounds are partly in Canadian waters; and

'Whereas the consent of the Canadian Government to such use of its waters has not been given:

'*Resolved*, That in the opinion of this commission application should be made without delay to the Canadian Government by the United States Government for formal permission to excavate the channel where that work is now progressing, and that such application when received by the Canadian Government should be granted, provision being made that the dumping grounds in Canadian waters should be located under the direction of the Minister of Public Works of Canada.'

O. H. ERNST,
Brig.-Gen., U. S. A,, Retired,
Chairman of American Section, International Waterways Commission.

WAR DEPARTMENT, WASHINGTON, August 9, 1909.

SIR,—This department is in receipt of a report from the local United State engineer officer at Detroit, Mich., in which he states that the Canadian government, through its engineers, has made inquiry by what authority the United States is depositing material in Canadian waters in the construction of the Livingstone Channel, Detroit River. He also states that the boundary line between the United States and Canada is not clearly defined, and that the Livingstone Channel occupies a location where it is difficult to state what portion is in American and what in Canadian waters. The matter was referred to the International Waterways Commission for report, and under date of 14th ultimo the commission passed the following resolution:

'Whereas the enlargement of the navigable channel in the Detroit River, now being made by the United States Government, west of Bois Blanc Island, is of great benefit to the navigation interests of Canada, as well as of the United States; and

'Whereas the excavations for said channel and the dumping grounds are partly in Canadian waters; and

'Whereas the consent of the Canadian Government to such use of its waters has not been given:

'*Resolved*, That in the opinion of this commission application should be made without delay to the Canadian Government by the United States Government for formal permission to excavate the channel where that work is now progressing, and that such application when received by the Canadian Government should be granted, provision being made that the dumping grounds in Canadian waters should be located under the direction of the Minister of Public Works of Canada.'

In view of the foregoing, and in accordance with the recommendation of the Acting Chief of Engineers, U. S. Army, it is requested that the matter be brought to the attention of the proper authorities of the Dominion Government with a view to securing the consent of that government to the use of its waters in connection with the operations now being conducted by the United States for the enlargement and improvement of the Livingstone Channel in the Detroit River.

Very respectfully,

JOHN C. SCOFIELD,

Assistant and Chief Clerk.

For the Secretary of War, in his absence.

The Honourable the Secretary of State.

DEPARTMENT OF STATE,

WASHINGTON, September 24, 1909.

The Honourable the Secretary of War.

SIR: Referring to your department's letter of the 9th ultimo, embodying resolutions adopted by the International Waterways Commission recommending that formal permission be obtained from the Canadian Government to continue the excavations now being made by the United States Government in the Livingstone Channel, Detroit River, on the condition that the dumping grounds in Canadian waters shall be located under the direction of the Canadian Minister of Public Works, I have now the honour to inclose a copy of a note from the British Ambassador at this capital, stating that he is advised by the Deputy Governor-General of Canada that such permission is granted upon the condition named, provided that such permission is considered to be given without prejudice to the possessory rights of Canada as defined by the maps and declarations of the commissioners under the Treaty of Ghent, made at Utica, on June 19, 1822, and provided also that the dumping of material should not prove in any way a detriment to the safe navigation of the Detroit river.

I have the honour to be, sir, your obedient servant,

ALVA A. ADEE,

Acting Secretary of State.

(Inclosure: From British Ambassador, No. 249, September 17, 1909.)

[No. 249.] BRITISH EMBASSY,
NORTHEAST HARBOR, ME., September 17, 1909.

SIR,—On the receipt of your note No. 691 of the 14th ultimo I referred to the Dominion Government your request that formal permission might be obtained to continue the excavations now being made by the United States Government in the Livingstone Channel, Detroit River, on the condition that the dumping grounds in Canadian waters should be located under the direction of a Canadian Minister of Public Works.

I have now received a dispatch from the Deputy Governor-General of Canada stating that such permission is granted upon the condition named, provided that such permission is considered to be given without prejudice to the possessory rights of Canada as defined by the maps and declarations of the commissioners under the Treaty of Ghent, made at Utica on the 19th of June, 1822, and provided also that the dumping of material should not prove in any way a detriment to the safe navigation of the Detroit River.

I have the honour to be, with the highest consideration, sir,

Your most obedient, humble servant,

JAMES BRYCE

The Honourable PHILANDER C. KNOX,
Secretary of State, etc.

APPENDIX B.

REPORT OF THE INTERNATIONAL WATERWAYS COMMISSION UPON THE APPLICATION OF THE CEDARS RAPIDS MANUFACTURING AND POWER COMPANY.

The Honourable the Minister of Public Works,
Ottawa, Ontario.

SIR,—The application of the Cedars Rapids Manufacturing and Power Company for permission to build works in the St. Lawrence River at Cedars, in the county of Soulanges, for the purpose of developing electric power, was referred to the International Waterways Commission by the Secretary of the Department of Public Works on the 18th of December last, with all papers relating to it.

An examination of the papers in question shows that on January 6, 1906, the Governor General in Council approved the project of the company, subject to the passing of an agreement between the company and the Department of Public Works, so as not to impede or interfere with the navigation of the St. Lawrence River, and in which the company will bind itself to construct and maintain all other works, which in the opinion of the Minister of Public Works, or of any engineer appointed by the Minister, may be deemed necessary to restore navigation on the St. Lawrence River in the Cedars Rapids, should navigation be injuriously affected by the works of the company.

The agreement in question was prepared by the law clerk of the Department of Public Works in 1906, pursuant to the order in council of the 6th of January, and was sent to the company during that year, but it was not executed by the company, presumably because the company was not ready to undertake the works at that time.

Nothing further was done in connection with this matter until October, 1908, when the solicitors of the company forwarded the draft of the agreement to the Department of Public Works, stating that, with a few minor changes therein, the company was prepared to execute this contract.

Shortly afterwards, in December, the departmental file was referred to the International Waterways Commission for its attention.

The commission, as a whole, understands that the reference was made with a view of obtaining its opinion as to whether or not the project outlined by the company in the plan submitted to the Department of Public Works would interfere with navigation, and in the event of interference, whether or not the agreement proposed to be executed between the company and the department is such as to safeguard the interests of navigation.

No detailed plans of the works have been submitted, and only the most general information concerning the topography and hydrography of the locality is at hand. The commission is unable to form opinions in detail as to the effect of the works, but it does not consider that fact a valid reason for reporting adversely to the scheme as outlined. It assumes that detailed plans will be submitted in due season to the Minister of Public Works. It is of the opinion that with such plans the scheme can be carried out under the agreement between the company and the government, a copy of which was laid before the commission, without detriment to navigation, except possibly raft navigation. To safeguard the latter, it would suggest that a clause be added to the agreement, providing that if it be found necessary, in the opinion of the Minister of Public Works, to pass the rafts through the power canal, the rafts shall have that right, and a proper slide shall be provided at the lower end of the canal.

The commission also suggests that the agreement be not executed until the company shall give proper assurance of its ability, financially and otherwise, to commence and complete their works within a specified time, and comply with all the terms of the agreement in every respect.

Respecfully submitted,

GEO. C. GIBBONS,
Chairman, Canadian Section.

O. H. ERNST,
Chairman, American Section.

GEORGE CLINTON,
E. E. HASKELL,
Members, American Section.

LOUIS COSTE,
WM. J. STEWART,
Members, Canadian Section.

TORONTO, ONTARIO, 13th April, 1909.

MEMORANDUM

FOR THE DEPUTY MINISTER OF PUBLIC WORKS

CONCERNING THE WORK OF

THE INTERNATIONAL WATERWAYS COMMISSION

SINCE MARCH 1, 1908, to OCTOBER 15, 1909.

Meetings of the full commission have been held at regular intervals, averaging about once a month, alternately in Toronto and Buffalo.

The subjects dealt with have been:—

I. Diversion of 40,000 cubic feet of water per second from the lower Niagara river in the vicinity of the Whirlpool rapids.

II. Article IV. of the treaty between the United States and Great Britain signed on the 11th of April, 1908, concerning the boundary line between the United States and Canada from St. Regis, Ontario, and to the mouth of Pigeon river, Ontario, commonly called 'Delimitation of Boundaries Treaty.'

III. Application of the Long Sault Development and the St. Lawrence Power companies for permission to dam the St. Lawrence river at the foot of Long Sault rapids.

IV. Application of the Cedars Rapids Manufacturing and Power Company.

V. Regulation of Lake Erie.

VI. Improvement in Detroit river.

VII. Effect of diversion of water through Niagara Falls Power Company's canal.

I. On the 24th of May, 1907, a Bill, No. 25546, relating to the diversion of 40,000 cubic feet of water per second from the rapids in the lower Niagara river, near the Whirpool, was referred to the American section by Mr. T. E. Burton, chairman of the Committee on Rivers and Harbours, House of Representatives U.S.A. This Bill, which was really an amendment to 'An Act for the control and regulation of the waters of Niagara river, for the preservation of Niagara falls and for other purposes,' received the careful consideration of a committee and afterwards of the full commission, and on the 3rd of March, 1908, a report was drawn up and signed by the full commission to the effect that 40,000 cubic feet per second could be diverted without seriously affecting the scenic beauty of the rapids, but that this amount should be equally divided between the two countries, and that, therefore, the Bill should be amended so as to grant only 20,000 cubic feet per second. This report of the full commission with the report of engineer W. Edward Wilson upon the effect on the river and falls of the diversion of water by the American power plants at Niagara Falls, is printed as appendices A and B annexed to the Fourth Progress Report of the American Section. See pages 682 and 683.

II. On the 11th of April, 1908, a treaty, entitled 'Delimitation of Boundaries Treaty,' was signed by representatives of the governments of Great Britain and the United States, and by Article IV., the International Waterways Commission was charged with the responsibility of carrying out the terms of this treaty as regards the boundary between St. Regis on the St. Lawrence river and the mouth of Pigeon river, Lake Superior.

This Article IV in full, reads as follows:

'The high contracting parties agree that the existing International Waterways Commission, constituted by concurrent action of the United States and the Dominion of Canada and composed of three commissioners on the part of the United States and three commissioners on the part of the Dominion of Canada, is hereby authorized and empowered to ascertain and re-establish accurately the location of the international boundary line beginning at the point of its intersection with the St. Lawrence River near the forty-fifth parallel of north latitude, as determined under Articles I and VI of the treaty of August 9, 1842, between the United States and Great Britain, and thence through the Great Lakes and communicating waterways to the mouth of Pigeon River, at the western shore of Lake Superior, in accordance with the description of such line in Article II of the treaty of peace between the United States and Great Britain, dated September 3, 1783, and of a portion of such line in Article II of the treaty of August 9, 1842, aforesaid, and as described in the joint report dated June 18, 1822, of the commissioners appointed under Article VI of the treaty of December 24, 1814, between the United States and Great Britain, with respect to a portion of the said line and as marked on charts prepared by them and filed with said report, and with respect to the remaining portion of said line as marked on the charts adopted as treaty charts of the boundary under the provisions of Article II of the treaty of 1842, above mentioned, with such deviation from said line, however, as may be required on account of the cession by Great Britain to the United States of the portion of Horse Shoe Reef in the Niagara River necessary for the lighthouse erected there by the United States in accordance with the terms of the protocol of a conference held at the British Foreign Office, December 9, 1850, between the representatives of the two governments and signed by them agreeing upon such cession; and it is agreed that wherever the boundary is shown on said charts by a curved line along the water the commissioners are authorized in their discretion to adopt in place of such curved line, a series of connecting straight lines defined by distances and courses and following generally the course of such curved line, but conforming strictly to the description of the boundary in the existing treaty provisions, and the geographical coordinates of the turning points of such line shall be stated by said commissioners so as to conform to the system of latitudes and longitudes of the charts mentioned below, and the said commissioners shall, so far as practicable, mark the course of the entire boundary line located and defined as aforesaid, by buoys and monuments in the waterways and by permanent range marks established on the adjacent shores or islands, and by such other boundary marks and at such points as in the judgment of the commissioners it is desirable that the boundary should be so marked; and the line of the boundary defined and located as aforesaid shall be laid down by said commissioners on accurate modern charts prepared or adopted by them for that purpose, in quadruplicate sets, certified and signed by the commissioners, two duplicate originals of each shall be filed by them with each government ; and the commissioners shall also prepare in duplicate and file with each government a joint report or reports describing in detail the course of said line and the range marks and buoys marking it, and the character and location of each boundary mark. The majority of the commissioners shall have power to render a decision.

'The line so defined and laid down shall be taken and deemed to be the international boundary as defined and established by treaty provisions and the proceeding thereunder as aforesaid from its intersection with the St. Lawrence River to the mouth of Pigeon River.'

On the 2nd of June, 1908, the commission met to discuss the work, and a committee was appointed to investigate and draw up a scheme.

This committee reported on the 23rd of June—

'That the existing charts were unsuitable for the importance of the work;

'That a uniform size of chart of 40 inches by 50 inches should be adopted, and that 30 charts would be required;

'That four scales should be adopted; $\frac{1}{10000}$ for Niagara Falls and St. Marys Falls: $\frac{1}{20000}$ for rivers; $\frac{1}{60000}$ for the wide open bays at the ends of the lakes, and $\frac{1}{300000}$ for the lakes themselves.

'That charts should be projected on the polyconic projection to the new United States standard datum;

'That charts should be engraved upon copper and a duplicate set of copper plates made, so that each government might have a set.'

It was estimated that the 'work of preparing charts, placing monuments, surveying and co-ordinating their positions and preparing a description of the boundary line would cost at least $160,000, half to be borne by each country.

The work of preparing the charts was started immediately in the office of the American section at Buffalo, where a staff of three draughtsmen and five engravers, selected in equal numbers from each country, is at work.

Charts of Detroit River, Lake St. Clair, St. Clair river, Lake Erie, west end Lake Erie, and three of the St. Lawrence river, are nearly drafted and about half engraved. Some necessary surveying work has started along the Niagara river, to obtain a triangulation upon which to base the co-ordination of the monuments and turning points.

Several interesting discussions over the boundary have been held, both in committee and in full commission, but until the large scale charts are completed no definite decision can be arrived at.

There is still a large amount of work to do, completing the charts,—placing the monuments and tieing them to the triangulation; then the preparation of the description in detail of the boundary as called by the treaty. This work will probably occupy a further period of three years.

III. In our progress report covering our work for the calendar year ending December 31, 1907, reference is made to the proposed power works on the St. Lawrence river, near Long Sault rapids. The question was again considered by the commission at its meeting of the 31st of October, 1908, when it was decided to consider, and, if possible, dispose of the matter at a meeting to be held in Toronto on the 20th of November; but before the latter date, a letter dated the 15th of November, 1908, was received from the Long Sault Development Company, which is the company interested in the development on the American side, stating that the St. Lawrence Power Company, Limited, which is the allied company interested in the proposed development on the Canadian side, was engaged in further surveys and studies and in preparing new plans, and that it was not the intention of the first-named company to introduce a Bill into the United States Congress until the plans for the entire project were definite and complete. However, at the meeting on the 20th of November, 1908, several deputations representing the vessel and timber rafting interests were heard in opposition to the project and were answered by the engineer for the power companies. See Appendix 'A.'

The Canadian section was not prepared, after that public hearing, to make any recommendation and decided to submit the question to their government. The matter was referred to a committee of engineers, composed of the chief engineer of the three departments interested, viz., the Department of Public Works, the Department of Railways and Canals, and the Department of Marine and Fisheries. This committee made a report to the respective heads of the three departments on Dec. 15, 1908, said report having been referred to the commission is appended marked 'A1.' Nothing further has been heard of the project.

IV. On the 23rd of December, a communication was received from the Secretary of the Department of Public Works referring to the International Waterways Commission, for consideration and report, an application from the Cedar Rapids Manufacturing and Power Company for permission to construct certain power works on the north side of Cedar Rapids, Que., and divert 56,000 cubic feet per second from the river.

The company was duly incorporated by an Act of Parliament of Canada, passed in 1904, Chapter 65, and was given power, amongst other things, to construct, develop, acquire, own, use and operate water-powers in or adjacent to the River St. Lawrence in the county of Soulanges, in the province of Quebec, and to construct, operate and maintain works, canals, race-ways, water courses, dams, piers, booms, dikes, sluices, conduits and buildings in connection with the said water-powers, provided that any work by the said Act authorized should not be commenced until the plans thereof had first been submitted to and approved by the Governor in Council.

On the 26th of January, 1909, deputations from the company were heard at a public meeting in Toronto, and on the 26th of February, at the office of the American section, in Buffalo, N. Y., a further public hearing was given to deputations from both the companies, and the Canadian Marine Association. For reports of these public hearings and for the documents submitted thereto, see Appendices 'B' and 'C.' On the 13th of April a report was drafted and forwarded to the Honourable the Minister of Public Works, recommending the granting of the application under certain conditions. This report is printed as Appendix marked 'B' to the fifth progress report of the American Section, dated Dec. 9, 1909. See page 698.

V. The question of the regulation of Lake Erie was one that was submitted for the consideration of the commission by an Act of Congress approved on the 13th of July, 1902, and informally discussed by the commission at its first meeting held in Washington, D.C., on the 25th of May, 1905. At that time a committee was appointed with instructions to gather a large amount of data bearing upon the hydraulics of the Great Lakes and connecting waters, and to draw up a report on the subject. This committee has been steadily at work and submitted on the 26th of February a very voluminous report bearing upon the question.

This report which has received a great deal of study from the other members of the commission, was brought up for discussion at a meeting held in Buffalo on the 14th of July, and referred back for more data. This is being gathered and a survey party is now in the field.

The scheme as proposed by Mr. Wisner of the Deep Waterways Commission, was to construct at the outlet of Lake Erie, between Fort Erie and Buffalo, submerged weirs from each shore connected by a series of sluices; the weirs to be of such height and combined length that, with all the sluices open, the overflow would be equal to the low water discharge, and, with the sluices all open, the discharge would be such as to keep the lake at the regulated level. In the spring and early summer, when naturally the surface rose, the gates would be opened to the full to prevent a rise above the fixed level and later in the season, when the surface was falling, the gates were to be so adjusted as to lessen the outflow and maintain the level. This would be an ideal condition for the navigation of Lake Erie if it could be arranged without entailing larger disadvantages to other interests.

VI. On the 14th of July, the attention of the commission was drawn to the fact that the United States government were making extensive improvements in the Detroit River opposite Amherstburg, partly in Canadian waters, and that the excavated material was being dumped in our waters, to the inconvenience of many persons, without any reference to the Canadian government.

The commission inquired into the matter and reported that as those improvements were for the general benefit of navigation of both countries and that Canada was not being asked to contribute anything, the United States government should be advised to ask the consent of Canada for formal permission to excavate the channel where that work is now progressing and that such permission should be granted, provision being made that the dumping ground in Canadian waters should be located under the direction of the Minister of Public Works of Canada.

VII. On the 14th of June, and again from the 19th to the 28th of July, both power-houses of the Niagara Falls Power Company's plant were closed down for inspection and repairs. Between the 28th of July and the 2nd of August, No. 2 power-house alone was closed.

The secretary of the American section was instructed to install gauges in the river at various points to obtain records of the effect upon the river and falls by the diversion of the considerable body of water used by that company. He was instructed to observe these gauges before, during and after they shut down.

By the diversion of 8,000 cubic feet of water per second, he concluded that the surface of Niagara river was lowered:—

At Grass Island (near intake of Niagara Falls Power Co.)	by	$3\frac{1}{4}$	inches.
Near Ontario Power Company's intake	"	$1\frac{1}{4}$	"
At Willow Island	"	$\frac{9}{10}$	"
At Prospect Point, crest of American falls	"	$\frac{4}{10}$	"

These results show that the American power plants divert from the Horseshoe fall a larger amount than was supposed.

The United States Lake Survey in 1907 determined the flow over the American fall as about five per cent of the total discharge of the river, considerably less than was supposed.

As the gauges, near the crest of the rapids, at Willow island and near the Ontario Power Company's intake, record practically the same rises in the river, viz., $\frac{9}{10}$ of an inch and $1\frac{1}{4}$ inches, it would seem to show that the same proportion holds, or that only five per cent of the 8,000 cubic feet passes over the American fall.

All of which is respectfully submitted.

THOMAS COTE,
Secretary, Canadian Section.

Office of the Canadian Section,
Ottawa, Nov. 1, 1909.

APPENDIX 'A.'

Public Hearing held by the International Waterways Commission in Toronto, November 20, 1908, on the project of the Long Sault Development Company.

Toronto, Friday, Nov. 20, 1908.

The Commission met in the King Edward Hotel, at 2. p. m.

Present:—Canadian Section: George C. Gibbons, Esq., K.C., Chairman. Louis Coste, Esq., C.E.; W. J. Stewart, Esq., C.E.; Thomas Coté, Esq., Secretary.

American Section: General Ernst, Chairman; George Clinton, Esq.; Prof. E. E. Haskell, W. Edward Wilson, Esq., A.S.C.E., Secretary.

George C. Gibbons, Esq., K.C., Chairman, Canadian Section, presided.

LONG SAULT DEVELOPMENT COMPANY.

This company was represented by James W. Rickey, Mem.A.S.C.E., Chief Engineer of the Long Sault Development Company and the St. Lawrence Power Company, Ltd., also Mr. Leighton McCarthy, counsel for these companies.

The following gentlemen were also present:—Francis King, Secretary Dominion Marine Association, Kingston, Ont.; H. A. Calvin, Esq., Kingston; C. J. Smith, Esq., General Manager, Richelieu Navigation Company; Frank Plummer, Canadian Lake and Ocean Navigation Company; C. H. F. Plummer, Canadian Lake Transportation Company.

Chairman—I think we will not take up time now by reading the minutes of the Commission, but will at once take up the matter of the Long Sault. I would ask Mr. Coté to read the letter from General Ernst to myself, which will show the present position.

Secretary Coté read the following correspondence:—

INTERNATIONAL WATERWAYS COMMISSION.

Office of Chairman American Section, Washington, D. C.
Room 606, Westory Bldg., No. 605 Fourteenth St., N.W.

November 17, 1908.

Geo. C. Gibbons, Esq.,
Chairman of Canadian Section, International Waterways Commission,
London, Ontario, Canada.

Dear Sir,—I have the honour to enclose herewith a copy of a letter dated the 15th instant, which I have just received from Mr. Arthur Davis, of the Long Sault Development Company. It is possible that the fact stated therein may change your arrangements for summoning witnesses to the meeting of the commission to be held at Toronto on the 20th instant.

Yours very respectfully,

(Sgd.) O. A. Ernst,

Brig. Genl. U.S.A. Retired. Chairman of American Section,
International Waterways Commission.

1 enclosure.

November 15, 1908.

ARTHUR V. DAVIS,
Pittsburg, Pa.

Brig. Gen. O. H. ERNST,
Chairman, American Sec. International Waterways Com.,
606 Westory Bldg., F. & 14th St., Washington, D.C.

DEAR SIR,—On the 4th instant, Mr. Wilson, secretary of your commission, advised me that the commission will meet in Toronto, Nov. 20 and consider the project of the Long Sault Development Company.

The Long Sault Development Company has practically completed its surveys and studies with respect to its development on the American side, and the location of the work in American waters will not be changed from the plan already submitted to your commission.

The St. Lawrence Power Company, Ltd., the Canadian company jointly interested in this proposed development, have however been making surveys and studies with a view to determining the height and location of dam which will result in the greatest improvement to navigation on the Canadian side. These studies are not yet complete and it is the intention not to introduce a bill into the United States Congress until the plans for the entire project are complete.

Should your commission desire, therefore, to postpone consideration at the Nov. 20 meeting, the completed plans for the development on both sides of the river will be submitted to you in ample time for your commission to make a report before any action on a Congressional Bill will be had. However, should you desire to make a report upon the proposition so far as it affects American territory, we believe you have sufficient data to enable you to do so.

Yours very truly,

(Sgd) ARTHUR V. DAVIS.

CHAIRMAN:—On receipt of this letter I wired Messrs. Butler and Anderson of the Department of Railways and Canals and of Marine Department respectively, to stop their coming here, but on arriving here I found certain gentlemen had already come on the assumption that the matter would be taken up. I think it is desirable that we should hear to-day what these gentlemen have to say. I take it for granted that they all understand the object and purposes of the companies, and the work that they undertake. If not, the engineer of the companies is here and if desired might give a short statement to any who are here before they address themselves to the commission. What is proposed by the companies?

MR. RICKEY: You mean, Mr. Chairman, just a brief résumé of what I stated last year?

CHAIRMAN: Yes.

MR. RICKEY: The proposition, gentlemen, that we presented to the commission last year was a plan for damming the St. Lawrence river in both Canadian and American waters. It called for the joint permission of both governments. It involves the complete damming of the river. The petition which we submitted to the commission in Toronto about a year ago was submitted to Parliament. In that petition we set forth our plans quite in detail, that is the general description of them, stating just where the dams were to be located, and the effect on navigation; where the proposed lock would be located, that we would build free of cost to the Canadian Government; and briefly setting forth the advantages to navigation. The petition closed with the request to construct these works so far as they lay in Canadian territory. Since that time, considerable opposition has been raised to our scheme; and with a view to a further improvement of navigation I have made additional studies that are not yet well enough advanced to call them plans or anything like that; they are merely studies to determine what might be the best height of dam to give the greatest possible benefits to navigation. We have always held that the paramount question here is the benefit of navigation. Unless we improve navigation, in view of the existing Cornwall canal, and under the plans we have proposed, there is no use for us to attempt to get permission to construct these works. The studies I have been making are not complete, and we would like to continue further and go into the question in detail. Before the Long Sault Development Company submits a bill to Congress, these plans will all be submitted to your commission, giving you much fuller data than you have at present, and at such time that you will have opportunity to go thoroughly over the whole subject. I believe, in brief, that covers the ground.

CHAIRMAN: I think it would be well now to hear from Mr. Calvin and others who seem to think they have general objections to the scheme, which Mr. Rickey may possibly be able to answer, at any rate, which the commsision ought to hear. Mr. Calvin is interested in navigation at this particular point, in the way of running his rafts, and perhaps he would say something to us.

GENERAL ERNST: I would suggest that the gentlemen be informed that this all goes down on our written record, and we will have it at disposal in future, just the same as it would be if delivered at some future time.

CHAIRMAN: Notes are taken of everything you say, and the commission will consider them whenever the matter is taken up.

Mr. CALVIN: Will we have an opportunity of being heard when the plans are complete? Because of course we are in the dark to a certain extent now.

CHAIRMAN: You certainly will, but I had this letter read so that you might understand the situation. We thought the plans were complete, and I did not know until last night of this change; but I thought that while you were here perhaps in a general way you would have something to say about it. You will have later an opportunity if you desire it, certainly.

Mr. CALVIN: Of course I am not an engineer, and I don't know whether seeing the plans would make any difference; perhaps not. But on general principles we are opposed to this, for this reason—that practically this is the only route by which timber in the hewn log goes down the St. Lawrence river. It does not go down the canal; it goes down through the river. Boats carrying large cargoes are compelled to take the canal at this point; but all the square timber that goes down by water—and practically that is all that is exported from the St. Lawrence—goes down by the river at this point.

Mr. COSTE: What is the size of your raft?

Mr. CALVIN: About 60 feet in width, and running from 220 or 240 up to 300 and 320 feet in length.

Mr. KING: You are giving the height of one dram?

Mr. CALVIN: That is the piece that goes down through the Long Rapid.

Mr. COSTE: It is immaterial to you whether it goes through the rapids or the lock?

Mr. CALVIN: It would, because the lock is a slow affair, and we are liable to disturb the navigation of vessels. They might object to a block like that in the canal.

Mr. COSTE: Is not that provided for in the regulations of the government locks? The moment you get your logs, that is all you want.

Mr. CALVIN: I don't see how you would make it other than an obstruction. Even in the time of building, it would be an obstruction.

CHAIRMAN: It is said there are only very few rafts now that take that course—your own being the main ones.

Mr. CALVIN: Ours is the main. Last year, 1907, we ran through there between 90 and 100 rafts of that sort. This year, on account of the dulness and general slump in affairs, the quantity of wood held back is rather more than usual; we are wintering larger quantities westward. I am not prepared to say exactly, but I think about 70 this year, perhaps not more than 67 or 68.

CHAIRMAN: About how many million cubic feet?

Mr. CALVIN: In last year's there would be probably 2½ millions cubic feet. This year probably about 2 millions; it might run to 2¼. The navigation of that stuff through the canal would be a terrible obstruction—I mean through the St. Lawrence canals generally—because it would mean more pieces than that. There is a piece 60 feet wide and averaging say in the neighbourhood of 250 or 260 feet long. If those were brought into a canal-size band, there would have to be two and a half times as many to bring it down to the ordinary St. Lawrence canal size, so that it would be anywhere from 200 to 300 lockages of stuff at that size, which you see is nôt quite a practicable affair. Driving us into the canal would be not only an unfair thing to ourselves, but an unfair thing to others.

Mr. COSTE: They don't drive you into the canal. Suppose they passed you through one lock?

Mr. CALVIN: I wouldn't be able to say now what the effect of that would be. I would like to see the plan.

Mr. CLINTON: How is the business management of rafting done ?

Mr. CALVIN: They are towed through the open reaches of the river. We would bind together probably half a dozen of such pieces as I speak of and make a tow for a tug. Down below Coteau Landing and Cascades they are in what we call single drams, and then down at Lachine again. At Montreal they are banded up again and towed down.

Mr. CLINTON: And the steam tug accompanies them all the way down?

Mr. CALVIN: She runs the rapids, but she runs the rapids alone, of course; they can't tow in the rapids. She runs down ahead of them. She tows them as far as she can safely, and then drops the pieces one after another and goes on ahead.

Mr. CLINTON: What I was getting at was your facilities for locking through. The tug is there, so that if you have slack water the raft can go right in the neighbourhood of the lock before you break up. If you did not have the tug it would create an additional expense and delay, because you would have to have a tug stationed there.

Mr. CALVIN: Yes, to take them through. I should think we would have to have a tug in any case. One boat would not do that work with any expedition, and more than they do now with the tow barges going through the canal. A tug outside on the river will take three or four barges, but when they get into the canal each barge has to be in charge of a tug.

Mr. CLINTON: Suppose the regulations should require that the company provide the necessary facilities to expedite the passing through of the logs?

Mr. CALVIN: I think that depends on the scheme. We have no data in front of us.

GENERAL ERNST: We have the general scheme. They propose some minor changes in it. It is not the canal exactly that you go through; it is a great big wide river.

(Map produced, and Mr. Calvin pointed out the channel through which his logs go.)

CHAIRMAN: What is the size of that lock?

Mr. RICKEY: That has not been decided.

CHAIRMAN: What is it on that plan?

Mr. RICKEY: I presume that lock would be 55 or 60 feet wide, and whatever length was required by the government. It would be ample for navigation.

CHAIRMAN: We are thinking of Mr. Calvin's rafts. I thought there was another place for rafts.

Mr. RICKEY: The size of that will be dictated by the Chief of Engineers of the United States Army, and he would undoubtedly take into consideration the requirements of traffic along the river, and provide for them.

Mr. MCCARTHY: We recognize also the right of your commission to obtain that information before you give your permission to see that the rights of Kingston are maintained.

CHAIRMAN: Perhaps you would explain to Mr. Calvin your plan, Mr. Rickey?

Mr. RICKEY: This will be somewhat a repetition of what I said a year ago. We proposed a dam from the lower end of Long Sault island to the upper end of Barnhart island, right across on the site of the present Long Sault rapids. The navigation that now goes down through the Long Sault rapids will then, in all probability, use the South Sault channel, and go through the South Sault lock. All craft that now go down through the South Sault channel, namely, the log rafts just referred to, the tug boats, and occasionally dredge boat, etc., will also go down through the South Sault lock. But I think it is almost contrary to supposition to say that any craft now going down through these rapids would, in view of a single lock here in the South Sault channel, take the longer route through the Cornwall canal; and to that extent any congestion, or any tendency towards congestion, in the present Cornwall canal will be made no greater than under present conditions.

M. Rickey then read a printed description of the proposed works and produced two maps showing the location of the proposed works. The maps are attached to this report mark 'Map 1' and 'Map 2'. The description reads as follows:

The following plan for developing the power of the Long Sault rapids is proposed by the St. Lawrence Power Company, Ltd,. a Canadian corporation, and the Long Sault Development Company, a New York corporation.

The St. Lawrence Power Company, Ltd., owns the power plant at the foot of Sheek island in the St. Lawrence river near Mille Roches, Ontario. Its water is drawn from the Cornwall canal on the north side of Sheek island, and electric power is furnished for the Cornwall canal and to Cornwall, Mille Roches, Wales and Moulinette.

The Long Sault Development Company is empowered by its charter to construct dams, power-houses, locks, and other works in the St. Lawrence river.

Both the Long Sault Development Company and the St. Lawrence Power Company, Ltd., have acquired the lands and riparian rights necessary for the construction and operation of the proposed power development.

These two companies acting independently can develop on their respective sides of the river only a small part of the total power available from the Long Sault rapids, but by co-operating they can develop the entire potentiality of the river and furnish abundant and reliable electric power to all districts in eastern Ontario and northern New York. All dams, power-houses and other works proposed by these two companies will be designed to use ultimately the entire flow of the river for power purposes.

MAPS OF LOCATION OF PROPOSED WORKS.

Map No. 1 shows Long Sault, Sheek and Barnhart islands, the Cornwall canal and the international boundary. The rapids are principally between Long Sault and Sheek islands. On the north side of Long Sault island the main channel is in international waters but a short distance below the rapids the main channel is south of Barnhart island. About ninety-five per cent of the whole volume of water in the river flows through the main channel south of Barnhart Island and is thus in United States territory, and the other five per cent passes through Little river and the Cornwall canal. The internatnioal boundary line follows Little river channel between Barnhart and Sheek islands and east of Barnhart island is again in the main channel.

Map No. 2 shows the St. Lawrence river from the east end of Barnhart island to the west ond of Croil island. It shows the channel that will be used under future conditions by boats using the South Sault lock described later on.

DAMS AND CONTROLLING WORKS.

A dam, for convenience called the 'upper dam,' will be built between the west end of Barnhart island and the east end of Long Sault island. At each end of this dam will be large sluice gates which will discharge about 100,000 cubic feet per second, a quantity equal to forty per cent of the average flow of water in the river. This dam will divert about half of the water now flowing through the main channel south of Barnhart island into the enlarged Little River channel for use in the power-houses near the east end of Barnhart island.

A second dam, called the 'lower dam,' will be built between the east end of Barnhart island and the Canadian shore, extending across the international boundary. Both dams will be built of solid concrete masonry, and of the most approved type.

In addition to the sluice gates at the upper dam, there will be at each of the power houses a sufficient number of sluice gates to control the water level above the dam.

POWER-HOUSES AND LOCK.

A power-house in Canadian territory will be built at the northeast end of the lower dam opposite lock No. 20.

A power-house and lock will also be built across the South Sault channel between the foot of Long Sault Island and the main shore.

One, or possibly two, power-houses will be built at the east-end of Barnhart island. A headrace will be excavated for supplying water from Little River channel to the forebay immediately above these power-houses.

GOVERNMENT APPROVAL AND CONSTRUCTION.

The engineering departments of the Canadian and United States governments will have jurisdiction over the design and construction of works.

CORNWALL CANAL CONDITIONS.

The Cornwall canal is 11½ miles in length, of which about 5 miles are formed by earth embankments. Between locks 20 and 21 there are more than 2½ miles of these embankments, which in places are subjected to over 35 feet head of water. When the proposed dams are built and the water in the river above them is raised to the proposed level, the present unbalanced pressure on the canal banks, between locks 20 and 21, will be eliminated, and all danger of a washout in this section of the canal will be removed. Below lock 20 the conditions will remain unchanged.

The break in the canal bank, near lock 18, which occurred June 23, 1908, blocked all navigation in the Cornwall canal for 17 days. Had the proposed South Sault lock been in operation at that time no delay would have been caused by this washout, since all boats could have used the South Sault lock.

SCENIC BEAUTY OF THE RIVER TO BE PRESERVED.

The scenic beauty of the river above lock 21 will not be affected. Below the dams the scenery will remain practically unaltered.

Objection has been made to the construction of the proposed dams on the ground that the obliteration of the rapids will decrease the number of tourist passengers. The only scenic change will be the replacement of the present rapids by long dams, over the crests of which the water will pass in two unbroken sheets of a combined length of one and a half miles and a height of approximately forty feet—nearly one-fourth that of Niagara Falls. This artificial waterfall will afford a sight that will be unique and will surely surpass in grandeur the scenery of the Long Sault rapids.

Under the present conditions the Long Sault is navigated by a single line of passenger boats making a daily trip down stream during the summer tourist season—June to September inclusive. Under the proposed conditions, which involve the construction of railroad transportation facilities to the site of the works, the scenery incident to the dams may be enjoyed by tourists throughout the year, and the construction of the dams will afford an opportunity for tourists to pass through the highest lift masonry lock in the world and to see the longest spillway dams that have ever been built. Such attractions will surely more than offset a trip through the Long Sault, which is generally conceded to be less picturesque and thrilling than a trip through any one of the five other rapids through which the tourist must pass between this point and Montreal.

EFFECT OF PROPOSED WORKS ON MARINE TRANSPORTATION COMPANIES.

While the passenger traffic at this point in the St. Lawrence river is confined to a single line, making one trip per day four months in the year, the freight traffic is large—aggregating per annum about 4,500 trips through the canal around the site of the proposed works. By reference to Map No. 2. it will be seen that, in order to get around these rapids, a freight steamer must pass through six locks on the down trip and seven locks on the up trip, while, when the proposed works are constructed, each trip will involve only a single lockage. Further, the passenger line referred to must at present make six lockages on the up trip as compared with one lockage under the proposed conditions. The net saving of the eleven lockages on a round trip will be from four and one-half to seven hours' time—a very great improvement and advantage to navigation.

EFFECT OF PROPOSED WORKS ON RAILROADS AND THE PUBLIC.

The power from the proposed works will be used by factories and industries to be established within the radius of electrical transmission from the power-houses. Raw material will be delivered to the factories from distant sources of supply and finished products will be sent to the world's markets. The new industries and factories will give employment to thousands of persons.

SUMMARY.

IMPROVEMENT OF NAVIGATION.

The present impassable rapids will be obliterated and in their place will be a broad and safe stream.

The velocity of the current in the Farran's Point and the Big Sny channels will be substantially lessened, and the dangerous side current now existing at the entrance to the Cornwall canal will be destroyed.

The South Sault lock will duplicate the means now afforded by the Cornwall canal for navigation past the Long Sault.

Duplicate navigation facilities past the Long Sault will insure shipping interests against delay due to failure or accident in either the Cornwall canal or the South Sault lock.

Boats passing the Long Sault will make a round trip in from four and one-half to seven hours less time than at present.

The South Sault lock will be owned by the United States Government and will be operated seven days per week during the navigation season. Like the Cornwall canal it will be toll free.

ADVANTAGES TO THE PUBLIC.

The construction of these works will afford abundant, reliable and cheap power to all districts within the radius of electrical transmission of power. Cheap power will create many new industries and will be of great advantage to those already established.

The construction of the proposed dams and power-houses will require the expenditure of many millions of dollars, which will be distributed among the transportation companies, manufacturers, tradesmen and workmen. It is impossible to estimate the amount which will be expended directly or indirectly for the construction of factories to use this power, but the amount will be many millions of dollars.

The power from the entire development will be used almost exclusively for manufacturing purposes and the products must be distributed by boat and rail, resulting in increased revenue to the transportation companies.

CORNWALL CANAL CONDITIONS.

The Cornwall canal will not be affected or disturbed in the slightest degree. Its present integrity and utility will be preserved. The proposed development is so planned that traffic in the Cornwall canal will not be affected by the development in any way whatsoever. The Cornwall canal will remain unchanged and will be open to traffic both during the construction period and forever thereafter.

When the water above the dams is raised to the proposed level, all danger of a washout of canal banks between locks 20 and 21 will be entirely and permanently removed.

Mr. Calvin: The water is swift now here and here—all along down here (indicating on map). Now, you are going to cut that off. How much of a drop do you expect there will be between these two points?

Mr. Rickey: About 30 feet, in round numbers.

Mr. King: At each dam?

Mr. Rickey: There will be 30 feet at this lock.

Mr. King: There will be more at the other.

Mr. Rickey: No, there will be about the same at the upper dam, and at this power-house at the foot of Long Sault Island.

Mr. Calvin: Are you going to make 30 feet in one lift?

Mr. Rickey: Yes.

Mr. Calvin: How much is the present lift in the Cornwall Canal?

Mr. Coste: 41 feet.

Mr. Calvin: How do you know you are going to have navigation down here when you cut off all this water here?

Mr. Rickey: At the present time about 96% of the discharge of the river goes through the main channel on the south side of Barnhart island. When we dam the South Sault channel by building the power-house at the foot of the Long Sault island, and when we build a dam connecting Long Sault island and Barnhart island, more than half the water which now goes down the main channel on the south of Barnhart island will pass over the lower dam. Now, if we cut the volume of water in two, we are going to cut the velocity in two, and hence improve navigation in this channel. As an actual engineering proposition I think you will approve of that.

Mr. King: Half of the water will be flowing down that channel, and yet the channel will be improved?

Mr. Rickey: Yes, because there is anywhere between 40 and 60 feet of water. I don't say it is going to reduce the depth 50 per cent; I say it will reduce the velocity.

Mr. King: No, the volume, you said?

Mr. Rickey: Yes, the volume and velocity.

Mr. Calvin: The velocity does not bother us. It is the depth and volume we want.

Mr. Rickey: The government charts show that there is anything from 40 to 60 feet of water in this channel. Those are the charts used by the Canadian Government, and they were determined by the American Government.

Chairman: How much would that be affected by these dams?

Mr. Rickey: According to my present figuring, this will be along in the neighbourhood of four or five feet. You will still have 35 feet of water in this channel. What depth do you want, Mr. Calvin?

Mr. Calvin: You cannot come down here without 7′ 6″.

Mr. Rickey: So if you had 10 or 15 feet of water, that would be ample?

Mr. Calvin: If 7 feet suffices at the foot of Long Sault now, then 10 feet in the future would be ample. Ten or 15 feet is all the water we need. I just question whether that is going to be there or not. You are cutting off the whole supply there. You say nine-tenths of the water runs down there now, and you are cutting it all off.

Mr. Rickey: No, pardon me.

Mr. Coste: It changes the current; it can't change the depth very much.

Mr. Calvin: He is going to cut that water off here and here (indicating) and have that Power house down here (indicating on map.)

Mr. Rickey: There is a nine-foot fall in the surface of the river from the upper end of Barnhart island to the lower end of Barnhart island. Now let us assume—which is the fact, and can be substantiated by the government charts —that there is anywhere from 30 to 60 feet of water in the channel on the south side of Barnhart island. Now, if no water at all went over the dam the water at the upper end of Barnhart island—

Mr. McCarthy: You have not told them yet that any water is going over that dam.

Mr. Rickey: I said half.

Mr. McCarthy: Mr. Calvin thinks that this is going to be a solid dam.

Mr. Rickey: Half of the water will go over this upper dam, because this dam is about the same length as the lower dam. Now, even if less than half the water went over, you would still have ample depth of water, because there is only a 9-foot rise from the lower end and to the upper end of Barnhart island, and you have a 40-foot channel, so that this would be a deep pool if all the water went down over the lower dam. Do I make that clear to you?

Chairman: I don't think there will be any great difficulty as to that depth being maintained. All that will be looked after by the engineers. Whether these improvements can be made under proper restrictions—

Mr. Calvin: That is engineering; it is not rafting. Do I understand the Canadian commission would have nothing to say as to what size that lock would be?

Chairman: In the first place, this commission—which I speak of as a whole, the American and Canadian sections—are supposed to deal with the entire scheme, which provides for water lock system, and all those details before it is granted at all. This is preliminary to all that. But assuming that they can provide proper locks, and all these things are done, what we are seeking is to learn from you gentlemen whether, as was suggested at Montreal and elsewhere, there is a general objection to the scheme which cannot be met by any requirements these people can fulfil.

Mr. C. H. F. Plummer: You have guaranteed that that water would be 15 feet here and 15 feet there. Would you give an absolute guarantee?

Mr. COSTE: Yes, absolute.

Mr. RICKEY: Absolute, without any qualifications whatever.

Mr. PLUMMER: And if it didn't afterwards work out, would you take out these works again?

Mr. RICKEY: Yes, we will go on record that when these works are constructed, there will be ample facilities for navigation for all practical purposes.

Mr. PLUMMER: That is 15 feet?

Mr. RICKEY: Yes, 15 feet or more in the channel on the south side of Barnhart island.

Mr. CALVIN: I want to go on record as opposed to the scheme because it is going to be detrimental to our interests. I can't for the life of me see why it won't. To begin with, we are to be hindered while the construction is going on, right off on the start. I would like to ask a question on that. What about arrangements during construction? How do you propose to let us go down the river while this work is being constructed, supposing permission were given?

Mr. RICKEY: At the present time, I have not gone into all the details as to just how each piece of work will be carried on, that is, the sequence of the work; but during the construction of those plants the chances are that the Cornwall canal will have to be used.

Mr. CALVIN: There we are knocked off right away. We have 200 or 300 lockages that are going to congest that canal at once. Our lockages would amount to as much as 15 or 20 new barges on the route running all the time, something like that.

Mr. KING: It would be more than your present numbers of drams passing over, because of the obstruction in the winter.

Mr. CALVIN: Yes. It would take about 200 lockages.

CHAIRMAN: How long would there be an obstruction?

Mr. RICKEY: The estimated time for constructing this plant is three years.

CHAIRMAN: How long would this obstruction exist with these rafts?

Mr. RICKEY: Approximately three years. That is just a rough estimate. But the question in my mind is—and that is one thing that I wish to take up and submit to your commission in detail—the exact number of boats that go through the canal; what percentage of time is occupied in boats actually passing through the locks, so that we could show that you could add so many more boats through there and not approach the period of congestion. The investigation I have made so far will not admit of the term congestion in the Cornwall canal except on Sundays, when the boats have been tied up and are all bunched together, and then there is a slight delay, but it could hardly be termed congestion.

CHAIRMAN: Perhaps you could explain in a word to Mr. Calvin as you have to the rest of us, why you think that your scheme will facilitate navigation by this one lock?

Mr. RICKEY: There seems to be a general misapprehension on this proposition; for instance, arguments have been presented that when this upper dam is constructed, all traffic that now goes down through the rapids will have to go through the Cornwall canal. That assumes that the South Sault lock is not to be used at all. As a matter of fact, about 4 hours' time will be saved to navigation interests by the use of this South Sault lock; that is, four hours' time on the round trip of the boats.

Mr. Smith: That is, the freight boats, not our boats, not the passenger boats?

Mr. Rickey: Not for the passenger boats going down, but on your round trip you will save time, because you have to lock back through the Cornwall canal and go through 6 locks, which takes you considerable time. Now, coming back under the proposed conditions, you will go through a single lock, which will make your round trip shorter.

Mr. Smith: From our standpoint, it would kill our connections. We couldn't make connection with Montreal the same day.

Mr. Coste: Put in more steam.

Mr. Calvin: And there has been no answer to my claim of obstruction as I see it; that is, we are shut out of the river for three years under the best possible conditions—shut absolutely out of the river that we have been using for eighty years, even under the best conditions possible.

Mr. Rickey: If you will allow me, I will give this all tabulated to the commission later on.

Mr. Calvin: We will have a chance to be heard again?

Mr. Rickey: Most assuredly.

Mr. Smith: Mr. Chairman, I am simply going over the same ground I spoke of before. With our company this is not an engineering proposition at all, neither am I going to discuss it from that standpoint. Such a scheme as is proposed would obliterate the Long Sault rapids, which in our opinion is an asset far more valuable to our corporation than any advantage that could be gained even if it is an engineering possibility—which we don't know anything about. At the present time, it takes us all of our time to meet the New York Central time card. All those trains are regulated to leave the large distributing tourist traffic gateways and get down the St. Lawrence river at an hour in the morning when passengers can be transferred. It is only during the two or three months in summer that we have the long daylight, even with the fastest steamers that we put on, that we are able to make this connection that day. Any delay—a delay of half an hour—would be a positive hindrance to that traffic. The tourist traffic of this country is a tremendous traffic. It is sought not only by ourselves but by all railway companies throughout the district; and anything done to interfere with the free flow of that tourist traffic would be a big injury to the Dominion of Canada. In our opinion that asset is just as valuable to the Dominion and to our company as Niagara Falls. I think if you made a proposition to obliterate Niagara Falls off the map you would raise a howl. To obliterate the Long Sault Rapids will raise a howl, and has already brought forth protests which I hold in my hand and will file with your commission. Every steamship interest in this country and the Montreal Board of Trade are objecting to the scheme simply because it is interfering with a navigable stream, and we don't see the commercial necessity of it. I will read a letter I received from the Richelieu and Ontario Navigation Company, Montreal, signed by Mr. J. V. O'Donahoe, Manager's Assistant.

'C. J. Smith, Esq.,
'Care King Edward Hotel, Toronto, Ont.

'Dear Sir,— Referring to my wire of this date as follows: Shipping Federation advise meeting of International Waterways Commission at King Edward Hotel eleven to-morrow, and suggest you attend. Long Sault question coming up. Mr. King wires will be there.'

Mr. Robb called up this morning, and said Mr. Allan had requested him to get in touch with you regarding a meeting of the International Waterways Commission to-morrow. It seems that the Federation have been notified of this meeting, and that the question of the Long Sault Development Company would come up, and they decided not to attend as they had already filed their protest, but they extend to us assurance of their support of any action that we may take along the lines discussed. It is snowing hard to-day, but we expect the boat will be made to get out all right about on time.

Yours truly,

(Sgd.) J. V. O'DONAHOE,

Managers' Assistant.

Mr. Smith: So far as our company is concerned, and I think other steamship companies, we would be all very glad to assist any power scheme, because it is in our own interest; but when you submit a power scheme that dams the St. Lawrence river, and for three years prevents our company from running the rapids, we think it should not be listened to for a moment. In addition to that, I understand that the government have stated that there is a statute that navigable streams are not to be interfered with. That is part of the policy of the country. In our opinion, this is a navigable stream. Under those circumstances we say that it is a detriment and a very serious one; also that if power is given to a corporation to harness up the St. Lawrence river there, there is no reason why the next rapids should not follow in succession; no reason why Lake Erie should not be dammed, and bring the water down over the Jordan. Besides, there are lots of water-powers right near this very power that is proposed. There is the Ottawa river there, that is not a navigable stream. I believe they furnish statistics showing that something like half a million horse-power can be converted on the Ottawa, that will serve the same district as this, that is, so far as the province of Ontario is concerned. By a transmission line I suppose it would serve New York State. Therefore, from a commercial standpoint we cannot see why our interests and the tourist interests of this country should suffer in order to develop power which while it would no doubt be of value, is not off-set by any transportation or other business interest commensurate with the loss. While these other shipping interests are not represented, Mr. King is here from the Dominion Marine Association. I have a letter also from the Shipping Federation of Montreal, which states that they will not be represented at this meeting, as they had already filed their protest, but stating that they would extend to our company the utmost of their support in any action that we may take along these lines.

General Ernst: How many people do you carry down there in a season?

Mr. Smith: I have no record with me. I can give it to you.

Chairman: About how many?

Mr. Smith: During the summer season we are carrying on an average 500 a day, and the business will increase. The boats that we are getting to-day are able to take care of 1,500 people per day. That is about the maximum number of people that we could take care of with the steamer. We have just finished one steamer which cost us $250,000. We are building another one, and this business is growing. It is not only that business; it is the business that goes on to our other line of steamers; it is the business that comes in to seek a water route from the United States and from Canada, to go down the St. Lawrence river. The rapids, we claim, is the particular feature of the trip.

Chairman: This rapid ?

Mr. Smith: Yes, we believe that the Long Sault rapid is of a different character; there is more volume. Some like the Long Sault; others like the Cedars; some prefer the Split Rock and others, Lachine; but the Long Sault rapid is the longest rapid, of more volume, and being the first rapid it naturally stands out more or less as the Long Sault. When you get through the rapids the Lachine is the last rapid. I think you can see what I mean—that the Long Sault rapid—

Chairman: How long would it delay you? The principle which this commission has to decide upon with regard to all these kindred waters is this—that the interests of navigation, which are paramount, have to be first considered, and no other diversion for power purposes will be considered if it interferes with navigation interests. It has been alleged, and a great deal has been said, and said with some force, that upon the whole—not dealing with the Long Sault rapids alone—the interests of navigation would not be impeded, but they would be facilitated. And the effect would be beneficial. That particular point, which has to be considered by the commission, is really the question at issue. The interests of navigation are paramount; but it is true that they would be helped rather than hindered by this improvement?

Mr. Smith: From our standpoint, we are building boats faster all the time. The great trouble is in transportation through the rapids; you can only get a certain draught, about five feet five, and you cannot get the power out of a boat of that capacity at a commercial cost. To get through our time-card, is about all we can do now.

Chairman: How long do you think that would hinder you?

Mr. Smith: I don't know, because I have not gone into it from that standpoint. I could figure it out if their engineer could tell me how much longer it would take us to get through from the entrance till we got out. If it was two hours, it is two hours, and I understand that Mr. Rickey said we would save about two hours on the round trip. Two hours faster, therefore, divide that in half, that would delay us two hours going down.

Mr. Rickey: No, I beg your pardon. In making up the average saving of time on the round trip, and the progress of passenger boats, I took something like 20 boats, including a larger proportion of passenger boats than freighters. The average saving of time on the round trip was four hours; the average delay to the R. & O. passengers going down will be about half an hour.

Chairman: That was stated by somebody before. That is why I called Mr. Smith's attention to it.

Mr. Smith: Well, unfortunately in locking we run up against delays of all characters, and a delay of half an hour would be injurious. The fact of the matter is that about the first of September in order to reach Montreal by night, we have to shorten our present time-card to leave Kingston at half-past five in the morning as against five, and we are already leaving Kingston too early. To get passengers out of their berths at 4 o'clock is pretty early for tourist business, to get them on to these boats to make the run at present.

Chairman: Will your new boats be any faster?

Mr. Smith: The new boat is faster, but she is not fast enough to do that work, and we cannot make them fast enough. In order to assist in this time-card we are going to more expense ourselves—putting up quick coaling plants and all that sort of thing by machinery, so as to overcome this. Unfortunately, in canalling, there are obstacles coming in the way, and it seems to me half an hour is too short altogether of a limit of time lost, for we might break that connection. I think it would be more like an hour or two hours, and when you are canalling you never know,what is going to get in the way.

Mr. Calvin: Rafts would be ahead of you.

Mr. Smith: If a raft is ahead of us, where would we be? Just a little suggestion of something like that shows what occurs.

Chairman: You can assume that Mr. Calvin would be ahead of you, anyway. (Laughter.)

Mr. Smith: Yes. Now, last summer we had an unfortunate break in the canal; but suppose there was ordinary work going along, you could see for yourselves how serious it would be, and change the whole complexion of the tourist trade that all lines in this country have tried to work up. We have our canal facilities there now, and we are running outside, and we intend to increase that business right along. Anything in the shape of delay would in our opinion be very serious.

Chairman: Mr. King, do you want to say anything yourself? I would like to have you speak on that one point, whether on the whole the interests of navigation would be facilitated or hindered by this improvement?

Mr. King: Anything that I say must necessarily be of a very general nature. At the moment we have not the full details before us; we have no engineering data before us; we have nothing but a plan upon the table and the discussion that has taken place. I would just like to reiterate—because the whole commission is here to-day—the statement already made by Mr. Smith, that the navigation interests of Canada are at present absolutely a unit in opposition to the scheme. The Dominion Marine Association, which I represent, has practically the whole tonnage from Montreal to Port Arthur and Fort William, and they have considered the scheme on more than one occasion with the information before them, and are at present absolutely opposed. I think the Canadian commission is seized of that fact already.

Chairman: We are not seized as well as we would like to be.

Mr. King: I am just pointing out that the opposition exists at present, and that is endorsed by the navigation also of the river, the Montreal Board of Trade, and all the other bodies. We are grateful to the commission for expressing the position that the governing principle behind the commission is that navigation interests will be paramount. We realize that acting upon that line we must show that navigation interests are here interfered with, or that the commission must satisfy itself on that point. We do not say that the obligation is upon us to satisfy the commission. It has been suggested that the navigation interests should be looked upon as a whole rather than as individual units here and there. Now, what are the interests going down the St. Lawrence? They may be roughly put under three classes. Mr. Calvin represents one, and he has shown you what a substantial class that is. Mr. Smith is a representative of another class, perhaps the most substantial, the passenger interests, and he has shown you how he would be affected. Now, we have not heard anything so far about freighters, but the two Mr. Plummers are here representing two of the important lines of baggage freighters carrying grain and baggage to Montreal and back. Then there are the Mackays of Hamilton, who go all the way down to Sydney, and many other boats, every one of which is directly interested in anything which is going to impede present navigation or block it. They may have 15 ft. of water offered to them, but this afternoon they are offered for a period of three years, at any rate, an additional complication of 300 drams of logs in the course of the season in the old Cornwall canal. Now, any navigator would protest against an addition of 50 drams of logs on the old Cornwall canal. Anything that is going to cause any additional impediment to navigation there is a serious one. Now, how far is the rafting industry to be affected? Mr. Calvin does not go over the whole ground. He starts at Garden island, where he makes his rafts. He has to make the raft; he has to reorganize the system of rafting which has been in operation for 50 years and over, ever since the company has been down to the foot of Wolfe island. I presume it would be a great source of expense if Mr. Calvin had to start to teach half-breeds and others how to build rafts over again. It is going to cost him more to make a narrower dram. While he now gets over the Long Sault by rapidly shooting it over and picking it up again at the foot of the rapids, he will have to go through the laborious operation of getting it in shape and getting it through and picking it up again, and getting out of the road of other vessels.

Mr. Calvin: I didn't go through all that detail because I am going to have another hearing, but I might say that a raft of timber constructed narrow enough to go through the Cornwall canal would be comparatively unsafe in the lower rapids. It would have to be about 38 or 40 feet wide. That would lessen the safety. There are several other points.

Mr. King: Perhaps as we are to have another hearing, there is no need for me to go into it.

Chairman: I think it is just as well for you to go on. I think the commission would like to hear the points.

Mr. King: When I have been asked directly whether navigation interests are being interfered with, how can we ignore the fact that Mr. Calvin is so seriously interfered with, as one of the three interests represented on the river? Mr. Smith is going to lose the most attractive feature of his own route. I speak feelingly there, because I would pick out the Long Sault rapids as the most attractive feature of the whole trip. As to the freighters, the proposal that they should have to permit these rafts—big, square drams, squared on each end—to navigate the Cornwall canal with them even for one season—such a proposal occurs to me as one of the greatest of detriment to their interests on the canal. The whole three points seem to be so clearly brought out at present that one doesn't have to refer to them again. But our protest goes further than that. Surely the asset which we now enjoy in the free and unobstructed passage down the St. Lawrence river, which is the natural outlet of the Great Lakes, is an asset which cannot be very lightly or readily taken away. One cannot estimate the detriment that may occur. One does not know how many other companies such as Mr. Smith represents may enjoy rights there. Have we a right to block the free natural channel of such enormous interests as this one? I am sure the commission is going to treat the matter very seriously. I know we are in safe hands, and I know that engineering representatives will be before the commission prior to any conclusive action. I was immensely surprised when I got the invitation yesterday to attend, because the matter was going to be considered and decided to-day. I know the commission is not going to decide without very full discussion.

Chairman: That notification was a mistake.

Mr. King: I know that was a *lapsus pennæ*. We ask the opportunity to say something more when we have the engineering data that will enable us to give some definite evidence.

General ERNST: I understand, then, the objection from the freight interest is simply the blockading of the canal during the course of construction, by the rafts?

Mr. KING: That is one. They cannot tell what the other objections may be. They are to-day offered a guarantee of 15 feet of water. I don't know which channel that will be in, and exactly what the character of the channel will be. It is impossible at present to estimate exactly what the objections may be that we will advance, but I suggest that at the moment as a serious one.

CHAIRMAN: Is there anything in the objections on behalf of the freighters' interest, that it would be a great saving to the vessel interests? Perhaps Mr. Plummer will say whether he agrees with that—that having one lock instead of six on the other side will be a great advantage, and that having this water more still and with less flow there would be a great advantage. It was urged very strongly upon us that taking the general freight business there would be a saving of several hours and an improvement of the whole system.

Mr. C. H. F. PLUMMER: This affects everybody the same as it does the freighters. There is no question that if everything is equal, one lock is better than seven. Of course that is unanswerable. But in this case it is on the American side. We don't know how it is going to affect the depth of waters here. These gentlemen say it is going to give us ample.

CHAIRMAN: Let us assume that it does. I want to go from point to point. It really does not make much difference which side the lock is on, because under the arrangement between the two governments, all these are the common right and property of the people of each country under treaty and arrangement. We can hardly block a system which is used over and over again. We want you to be broad with us. Each country has a right to use all this water, and they now use it. We have a right in their canals; they have a right in ours, and that is going to be made more permanent by treaty. Assume what they say is true.

Mr. PLUMMER: Assuming that there is 15 feet of water here, and one lock, and that Mr. Calvin's logs after three years do not have to lock through that one lock—

CHAIRMAN: Leave Mr. Calvin's logs out at present.

Mr. PLUMMER: That is a vital point to us. We have got nine boats; we make propably 90 lockages during the season, during the 10 trips to Montreal. If Mr. Calvin has to go through that one lock and make 300, it is going to hurt us. I would rather have 7 locks and not have Mr. Calvin. If he is not going through there, and then there is 15 feet of water, I say let us rather take this.

Mr. CALVIN: How am I going to get down?

Mr. PLUMMER: If you go through with 300 lockages, I would rather have 10 locks in the present Cornwall canal.

Mr. COSTE: Are you running the rapids?

Mr. PLUMMER: No, we lock all the way through, up and down.

Mr. COSTE: Then this scheme would not affect you at all, because you take the Cornwall canal, which would be improved. You take the Cornwall canal to-day, don't you.

Mr. PLUMMER: Yes.

Mr. COSTE: Both going down and up?

Mr. Plummer: Yes.

Mr. Coste: Then it would not interfere with you in the slightest.

Mr. McCarthy: You would rather have two methods of getting up and down than one. The only thing you fear is Mr. Calvin's logs?

Mr. Plummer: Yes. Isn't it reasonable for any one to want to have two ways of getting out of a house?

Mr. Rickey: I would like to explain about this 3 years' construction period. A question was raised as to how long we were going to dam this channel, and as I recollect, at that time I said that I had made no careful study of it, that I had not gone into the details. I simply made an off-hand general statement that it would take approximately three years. I don't know; it might be done in much less time than that, and I wish to make that—

Mr. Smith: Or it might take more?

Mr. Rickey: No; there is enough money invested here to make one hustle right from the start, and if you don't hustle your interest charges are going to eat you up. Now, while this South Sault channel is being constructed, all the traffic that now goes through the Long Sault rapid can still continue to go there. We don't interfere with that at all. All the work in the South Sault channel will be finished before the Long Sault channel is touched.

Chairman: Then do you say there would be no obstruction to the present channel while that construction is going on?

Mr. Rickey: There will be no obstruction in the main rapids while the South Sault work is being constructed.

Mr. Coste: And none at present in the Cornwall Canal?

Mr. Rickey: None at present in the Cornwall Canal.

Chairman: You did state it before so that we all got the impression that for three years the whole system would be blocked.

Mr. Rickey: Yes; that is the particular point that I wish to correct. It was clear to my mind that there was a *lapsus linguæ* through which a wrong impression was conveyed.

Mr. McCarthy: And while the Long Sault work is being performed, Mr. Calvin's logs can go down as they do now.

Mr. Calvin: They use that channel. (Indicating on map.)

Mr. McCarthy: They could use the other channel.

Mr. Calvin: I don't know. They never have gone there.

Chairman: During the time that this is being constructed is there a way that your logs can go down?

Mr. Calvin: I couldn't speak positively of that, but I think that is very doubtful.

Mr. Coste: In case of damage we would indemnify these people. (Referring to Mr. Calvin.)

Chairman: That is very rapid, is it?

Mr Calvin: Yes, and very rough. That is why the scenic effect is good.

Chairman: They go through the locks?

Mr. Rickey: My figures will show that to you conclusively.

Chairman: During construction, would it be for all of three years that this channel will be closed to Mr. Calvin's logs?

Mr. Rickey: I don't know how long it will take. I don't think it will take three years' time. It may take considerably less than three years, but there is a period that this channel will necessarily be blocked. (Indicating South Channel at power-house.)

Mr. Frank Plummer: Do you mean three continuous years?

Mr. Rickey: I mean three chronological years. There are certain periods you cannot work there.

Mr. Stewart: Could a timber slide be put in there similar to the timber slide we have at Ottawa for passing rafts?

Mr. Calvin: The cribs that pass down there draw very little water.

Mr. Stewart: They are very small.

Mr. Calvin: And very shallow. There is only one tier of pine timber. You couldn't run an oak raft over that slope.

Mr. Stewart: How many tiers have you?

Mr. Calvin: Three. It draws about 3½, 4 and sometimes 4 feet 2 inches of water—big, heavy blocks.

Chairman: And some hardwood timber?

Mr. Calvin: Some is hardwood, some pine.

Mr. McCarthy: The most of it is pine.

Mr. Calvin: About half and half.

Mr. Clinton: After you undertake the work on the South Channel, is the river going to get water enough for vessels to pass down here for a considerable space of time until these dams are completed?

Mr. Rickey: Yes, I would like to explain. The general way we would construct this would be to build a dam with the power-house and lock at the east end of the South Sault channel. We would build that first and have it all completed. Then as soon as that is done the log rafts, etc., can come down through this lock and go down the river. After this is done we will undertake the construction of the upper dam, and until we undertake that construction, the passengers boats can shoot the rapids the same as they do now, and when that channel is obstructed, boats can, without the least delay, come down through the South Sault lock.

Mr. Calvin: In order to construct this, there would have to be a dam right across there? (Indicating.)

Mr. Rickey: A coffer dam.

Mr. Calvin: That part of the river would be blocked? We could not use part of that river while that is building?

Mr. Rickey: I cannot answer that question off-hand without considering it in detail. Something like that might be worked out.

Prof. Haskell: I would like to ask Mr. Calvin how many years he expects his timber to keep up ?

Mr. Calvin: I cannot tell you that. We have been at it a long time; we are there still. When I was a boy people said it was only going to last five or ten years, but I am pretty gray and it is there yet. It is a big country, and there are big lakes and big tributaries. Some of this timber comes down from West Virginia and Kentucky, but it comes down this way because it is the best way. West Virginia and Kentucky oak comes to us now via Toledo.

Prof. Haskell: Does it go there by rail?

Mr. Calvin: By rail. It runs down the streams into the Ohio river, and the different Ohio roads carry it up by rail to Lake Erie ports, and we pick it up there and bring it down.

Chairman: Is it mostly for shipment across?

Mr. Calvin: It is all for shipment across to Great Britain. That is the hardwood side of it. Michigan and Wisconsin, elm; Pine timber from Idaho; and pine timber from Cobalt and Timiskaming and north shore of Lake Superior. It fans right out like that, and drops into the St. Lawrence, the big water.

Mr. King: Perhaps while we are all here together our minds might be disabused of the idea that is prevalent that the control of the situation would lie with the power companies.

Chairman: In what way do you mean?

Mr. King: The absolute control of the water, for one thing; the depth of water; the operation of the lock.

Chairman: Absolutely no.

Mr. King: It would be absolutely under the government?

Chairman: Yes. No permission would be given to anybody that does not give complete and absolute control to some representatives of each government, whatever form it takes. At present this commission may be given greater power to deal with these questions relating to boundary waters; but at all times they will be subject to the control of some body so that the interests of navigation will be protected to the utmost. There is no danger at all from anything of that kind, not the slightest. The one great big point here, and the only one point, is whether these proposed improvements—which ought to be granted if they are not an injury to navigation—will be an injury or a benefit upon the whole—and you have to look upon them as a whole. Now, that is all there is to it. You need not be afraid but that the matter will be very seriously considered by all the members of the commission who will seek to get at the principle and do what is right under the principles established, and which are the only proper principles to govern them in dealing with what are international waters. We do not want and must not allow any little jealousies between the two countries to arise. Nobody has any property in this water; it is not American water, it is not Canadian water; it is common use.

Mr. King: My point was more as between the power company and the other companies than between the two governments.

CHAIRMAN: Don't make any mistake. That is absolute. The interests of navigation are never surrendered by either government anywhere. I want you to understand that absolutely.

MR. CLINTON: The improvements at the Sault are absolutely under the control of the governments.

CHAIRMAN: Any improvements made at the Sault can be taken down at any time. We can compel them to take down anything.

GENERAL ERNST: It has been shut off completely twice.

CHAIRMAN: Yes; General Ernst calls my attention to the fact that they have cut off the water absolutely from the power companies at the Sault twice. I must confess they have done much more to carry out the spirit of the principles than our commission. This whole commission, as you know by our reports, have put themselves on record as strongly as they can in the English language as establishing their intention to preserve the levels of these great lakes, and, uphold the interests of navigation as paramount over every other interest; but where we can without injury to these interests permit the development of power we would do it.

MR. C. H. F. PLUMMER: If you back up the water 30 feet, is there not a chance of that water getting out some other way?

CHAIRMAN: That is a matter of detail, too.

MR. PLUMMER: We have little enough water there now.

CHAIRMAN: We will ask the government engineers, Mr. Butler and Mr. Anderson, and if there is anything injurious in that it will not be permitted. All we are troubling you with is whether the danger will be specific. These other matters will be taken care of in an engineering way. Of course, Mr. Smith, you agree, as everybody does, that it is a good thing to have these power developments if we can. Do you think it is possible that any scheme could be devised by which something could be made up to you? You cannot get away with the loss of time that it will take you to lock through, and you will have to add to that the limit incident to delay. That would seem to be one considerable objection; but on the return trip, if what we are told is true, you would save considerable time for your boats and considerable money value by having only one lock and a much easier passage on return. On the whole, do you think it is not possible to make this scheme so that it will be an advantage?

MR. SMITH: I would be only too pleased to make an appointment with their engineer and go into it practically. I am not an engineer. I would have to engage one for our company. We would have to discuss it, but if the rapid was obliterated I don't see how we could be compensated. We are just about building another boat: we have to have a spare boat. There will probably be two boats running down the rapids next summer, and Mr. Plummer's nine boats are going to be augmented, and there will be those nine boats. If we are going to take advantage of the St. Lawrence for the tourist business, we must take time between daylight and dark. We cannot get to Montreal and through the Thousand Islands by daylight by going through the canal.

MR. CLINTON. Suppose you were given the right of way in locking?

MR. SMITH: It takes too long. We have to operate them for all they are worth to get them through the rapids.

MR. CLINTON: I mean so far as delay by other traffic in locking is concerned?

Mr. Smith: We have that now. The passenger boats are given the right of way.

Mr. Clinton: Suppose that is preserved to you in this lock ?

Mr. Smith: It would be natural, it follows.

Mr. Clinton: The question in my mind is, to what extent the traffic by freight boats would interfere. I am not speaking of rafts now at all.

Mr. Smith: Of course that is all data I could make out for you. Sometimes we can get through the canal in 3 hours, and sometimes it is 5 or 6 if we run into obstacles. If we meet with obstacles it kills the trip for that day, and throws the whole of those people out of their whole connections and everything.

Mr. Clinton: What I had in mind was, that freight boats going down the South Channel might at times conflict with you in making time by keeping you away from the lock.

Mr. Smith: It would, if they were there.

Mr. Clinton: But suppose you were given the right of way, and so instructed that you could use it except as against boats actually locking, would the chance of delay on account of the freight traffic really amount to anything?

Mr. Smith: I don't know whether it would or not. The answer to your question would have to be figured out and discussed. A freight boat cannot always give you the right of way even if she wants to. Conditions arise that make it impossible. There are certain winds and one thing or another by which we are delayed half an hour. Frequently we get into a pocket and can't get out, and have to wait. But as to assisting in any way by giving it time or going into it more fully or answering questions, I would be very glad.

Chairman: I would suggest to you, Mr. King, that it would be a wise thing, and helpful to this commission, if we had some engineer before us showing somewhat on your side. We have one on the other, and then the government engineers would have their opinion, and they could confer with representatives of the company when these details arrive so that you will come to a conclusion as to what you differ about.

Mr. King: I moved over to this chair for the purpose of dropping into Mr. Calvin's ears some remarks very much to the same effect. We were asked, in fact we were given, an opportunity to have an engineer, and it was then thought wise by the association not to commit itself to the care of any particular engineer and run the risk of the navigation problem being decided by an engineer who might not have full regard to all the navigation interests such as the minor questions that are raised to-day. Now, I understand the matter has been referred by the Dominion Government to three engineers; but it has seemed to me that it would be very proper if they would condescend to consult representatives of this association before they finally submit their report either to the commission or to the government. We would be very glad to go over the matter with them and deal with the various points which we are unable to discuss intelligibly to-day.

Chairman: I think it would be very desirable if they would consult both your engineer and the other.

Mr. McCarthy: Mr. King does not propose to name an engineer. They shy at that every time.

Chairman: I think you should name your expert to consult with him, because our expert thinks that he cannot advise you two. Choose an expert to represent you; the company are represented by engineers; the government are represented by engineers. The commission have to use their best wisdom and decide what in the end would be the best report. Now, it seems to me if you get together with your engineer and the company and government engineers you would thrash out among yourselves a great many things and eliminate them, and when we come here there would be some definite issue.

Mr. CALVIN: The company's engineer, the engineers appointed by the Canadian portion of the commission, and the proposed engineer who might represent the navigation side, are all engineers and are looking at this matter from an engineer's point of view, whereas the most important thing so far as the Marine Association and ourselves are concerned is the navigation interests and not the engineering portion of it or the power development side of it.

CHAIRMAN: There are two distinct things. If we could eliminate the engineer, and get some result from that, then the commission, who are dealing with it from the general basis, would have something to go upon. It has always seemed to me more satisfactory if, having heard the company's expert, we could hear what your expert has to say on the other side.

Mr. CALVIN: Then we would have to put it this way—we would need two experts, one on the engineering side, and one on the navigation side.

CHAIRMAN: Yes; you could have a dozen if you want to, but do give us an engineering expert. Have you any idea, Mr. Rickey, when you will be prepared with those plans?

Mr. RICKEY: No, sir, I have not. I want to go into the whole matter fully, and give you tables so that when any of these points arise I can say those are the facts of the case. That will take considerable time. I have to go through the canal records to show the actual percentage of time those locks are free, and the number of boats. From that you can see the effect of putting 100 more boats into the canal and that they will take up so many more per cent of the time during the 24 hours.

CHAIRMAN: Is there anything of that you could put in writing so that the commission, if they see fit, could communicate to these gentlemen interested the engineering requirements so that when we meet something could be thrashed out?

Mr. RICKEY: I think so.

CHAIRMAN: It seems to me that we all keep getting the preliminary end of it. If the commission could say, 'Now, this is the proposition,' and send it out to all those people and thrash it out, it would be better.

Mr. RICKEY: We are all around on the outside of the field here. We all ought to get in together and thrash the matter out.

Mr. KING: Let me, on behalf of the navigation interests any way, thank you and thank the American members of the commission as well, very cordially for the opportunity given us to-day to say something, and thank you as well for the suggestion now made, which I hope may be carried away as an understanding—that something definite will be put in writing or in print, accompanied with some plans, so that we may get together and give it the rational consideration it deserves, with the assistance of experts, and give you something definite, rather than meeting over the table and discussing it informally in this way.

CHAIRMAN: You understand why that is suggested at this time?

Mr. KING: Certainly.

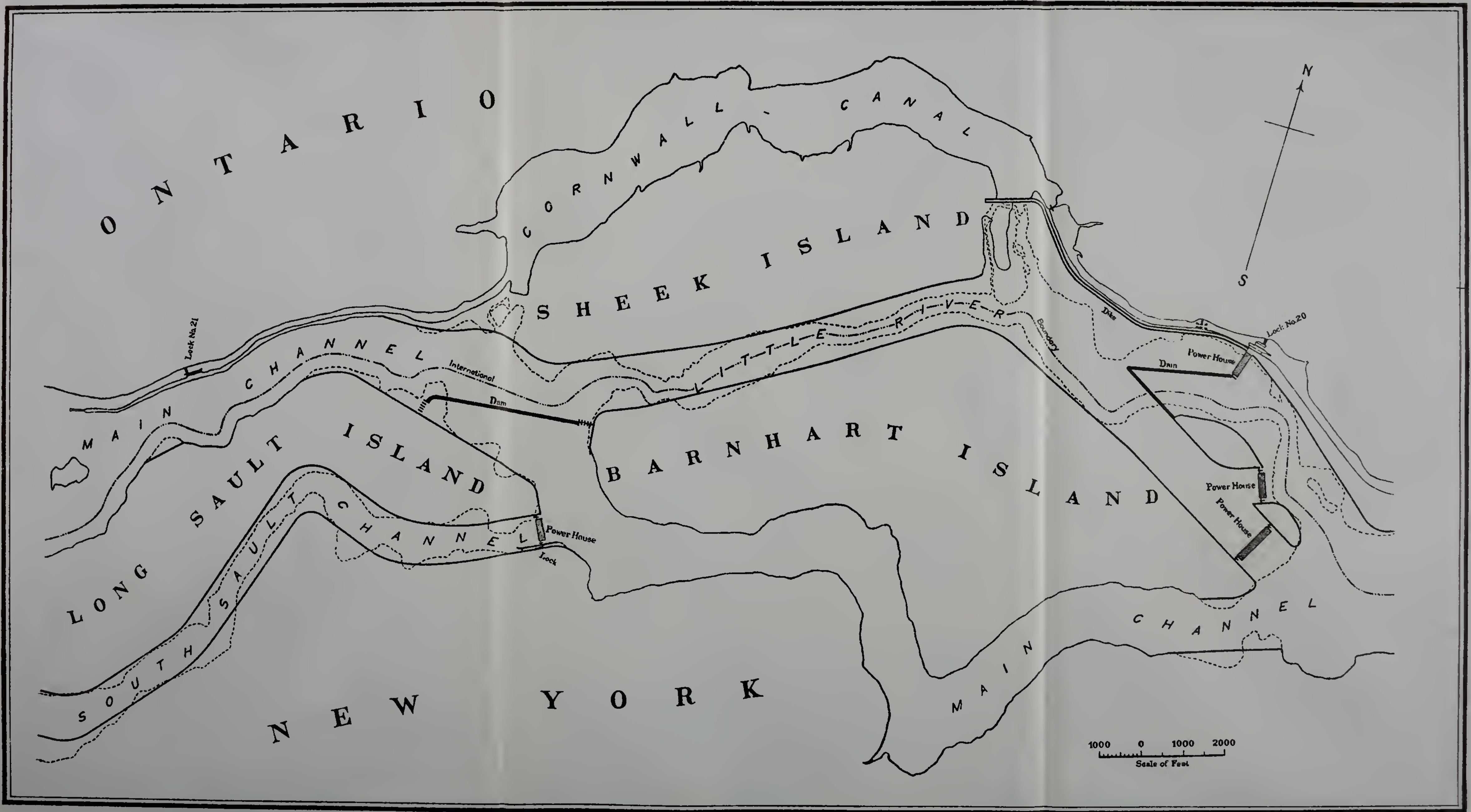
Deputation withdrew at 4 p.m.

MAP SHOWING LOCATION OF

DAMS, CANALS AND POWER HOUSES

PROPOSED BY

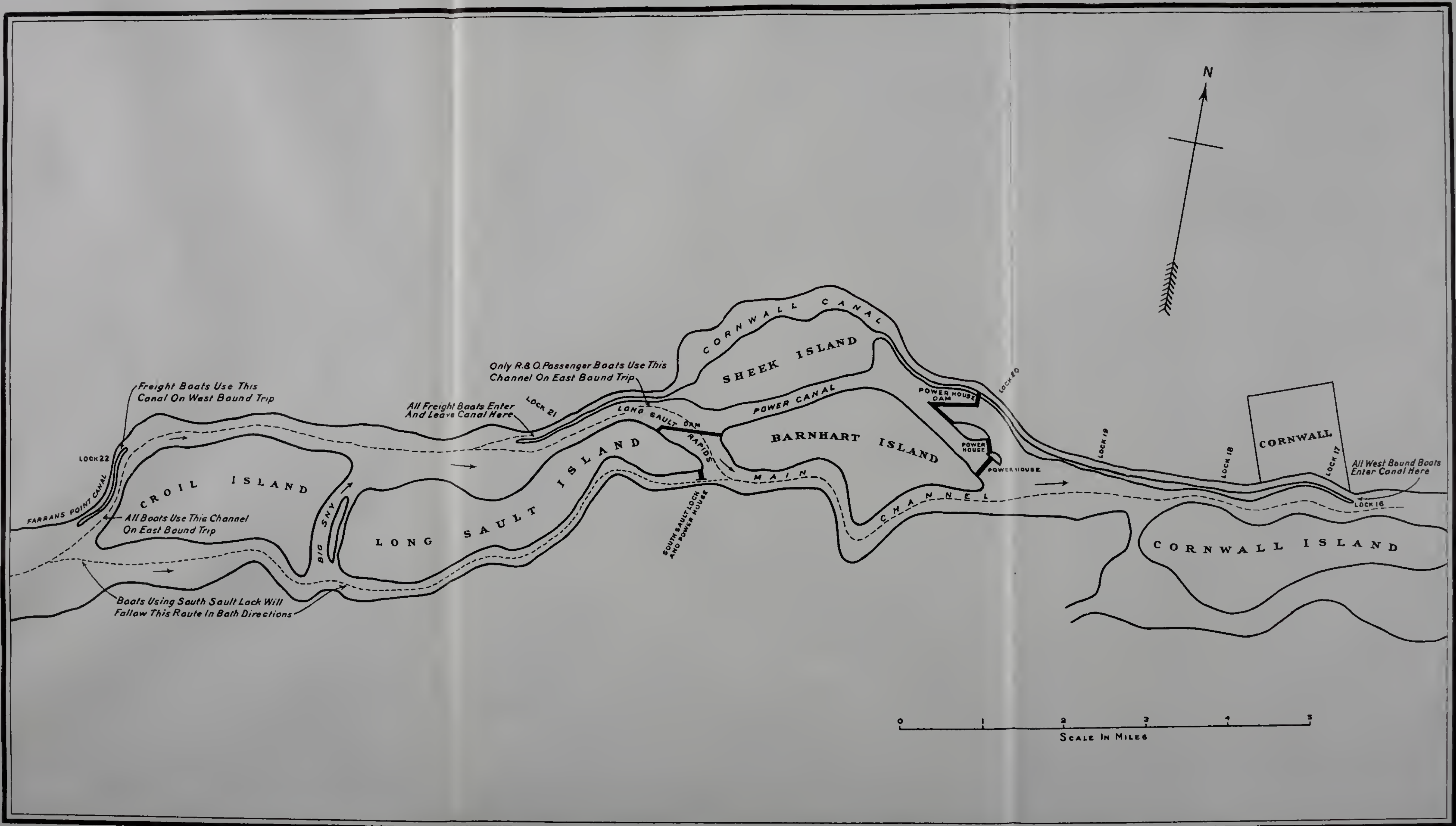
ST. LAWRENCE POWER CO. LIMITED, AND LONG SAULT DEVELOPMENT CO.



Plan I.

MAP SHOWING

ST. LAWRENCE RIVER, BETWEEN CORNWALL AND CROIL ISLANDS
AND
CHANNELS USED BY FREIGHT AND PASSENGER STEAMERS
UNDER PRESENT AND PROPOSED CONDITIONS


N
Freight Boats Use This Canal On West Bound Trip
LOCK 22
FARRANS POINT CANAL
CROIL ISLAND
All Boats Use This Channel On East Bound Trip
BIG SNY
Boats Using South Sault Lock Will Follow This Route In Both Directions
LONG SAULT ISLAND
All Freight Boats Enter And Leave Canal Here
LOCK 21
Only R.& O. Passenger Boats Use This Channel On East Bound Trip
LONG SAULT DAM
RAPIDS
SOUTH SAULT LOCK AND POWER HOUSE
CORNWALL CANAL
SHEEK ISLAND
POWER CANAL
BARNHART ISLAND
MAIN CHANNEL
POWER HOUSE DAM
POWER HOUSE
POWER HOUSE
LOCK 20
LOCK 19
LOCK 18
CORNWALL
LOCK 17
All West Bound Boats Enter Canal Here
LOCK 16
CORNWALL ISLAND
0
1
2
3
4
5
Scale In Miles

Plan 2.

APPENDIX 'A-I'.

POWER DEVELOPMENT AT LONG SAULT RAPIDS.

OTTAWA, December 15, 1908.

HON. GEO. P. GRAHAM,
Minister of Railways and Canals,
Ottawa.

SIR,—We have the honour to report in regard to the petition of the St. Lawrence Power Company, Limited, to His Excellency the Governor General in Council, for permission to erect certain dams on the St. Lawrence river, as follows:—

No detail plans are before us and our report is predicated upon the information submitted.

First: A rough computation shows that it is possible to develop, approximately, 800,000 effective horse-power by the proposed dams; and that the creation of such an enormous quantity of power would be of very great importance to the district in question, as experience has shown that in the proximity of such large developments of power, great industries are created; towns and cities grow up. The objections which arise, are somewhat serious. First: The plans, as submitted, contemplate interfering with the present Cornwall canal; and this we take it, cannot be tolerated. The integrity of the Cornwall canal must be preserved, without any alteration whatever; and consequently, the plans submitted would have to be modified so as to preserve intact this most important navigation channel. It is true that the company contemplate the building of a separate lock above lock 20 to enter into the proposed new level, but such a lock requires navigation to pass along parallel with an overflow weir dam, which, necessarily, must take care of the great bulk of the discharge of the river; in consequence thereof, the side currents would be so great as to render navigation exceedingly dangerous. Furthermore, an accident to any of the dams would throw the whole system of navigation out of gear for a long time

Second: The plans contemplate a single lift lock on the American side, in the south channel, to take the place of the Cornwall canal. The channel from this proposed lock to the foot of Cornwall Island has such a swift current and is so crooked as to render such a route dangerous; and it is not, therefore, in our opinion, a suitably located lock, having regard to the difficulties named. It does not seem needful at this stage to point out a more suitable site where a lock might be had, and where the difficulties of navigation would be lessened.

Third: The upper dam provided for in the proposed plans, running from the Long Sault island to the upper end of Barnhart island, is practically parallel with the thread of the stream, and is intended to be an over-flow weir, with ten stoney sluices at each end of it. There can be no doubt whatever that this dam will, of necessity, have to take care of the regulation of the level of the river above it. The lower dam at the easterly end, which is in the form of the letter 'A', connecting the mainland on the Ontario side with the lower end of Barnhart island, would not, in our opinion, be of material assistance for regulation.

Every advantage has been taken of the natural channels for the purpose of providing an economical development of the power, practically closing up the entire Canadian channel by this means and throwing the whole of the discharge into the American channel on the south of Barnhart island, the water to the north of Barnhart island being thrown into a pool.

The discharge over the upper dam in conjunction with the stoney sluices would be of such volume, and the cross current so great, as to make it risky for a steamer to attempt to pass parallel with this dam, through the south of Sheek island.

Fourth: The effect of ice and frazil on the up-stream end of the river is one upon which it would be most difficult to express any decided opinion. There is no doubt that frazil forms in the Galops rapids, and the Rapide Plat; and that a large mass of more or less broken ice floats down the river continuously. The channel in the vicinity of Brockville is usually kept open for the ferry; but after the dam in question has been built, a field of broad ice would be formed above its crest, and it will be difficult to say where the small cakes of ice, frazil and anchor ice would go, if it did not fill up the space above the dam. The report of the Montreal Flood Commission of 1889, states that on the 8th of April two or three feet of board ice and from ten to twenty-four feet of frazil were found. That between the Lachine rapids and Varennes, in March, 1887, a distance of 20 miles, there were 99,216,000 cubic yards of field ice, and 252,601,000 cubic yards of frazil, and water amounting to 467,212,000 cubic yards, or a total of 819,029,000 cubic yards, which gives some little idea of the relative proportions.

The conditions for the creation of frazil were greater in the district just above described, than in the one we are considering. Nevertheless, there is ample opportunity for the creation of great quantities of frazil and broken fragments of solid ice at the points named, so that the up-stream effect likely to be created is something that no one could very well predict; but would, no doubt, be approximately similar to that found by the commission, with resulting damage at the foot of the Rapide Plat and the Galops.

Fifth: The Richelieu and Ontatio Navigation Company run a daily line of steamers from Kingston to Montreal, and do a fairly large tourist business, which we understand is increasing. One of the features of the trip is running the Long Sault rapids, which, of course, would be destroyed by the proposed dam. Aside from this, we question if a boat could make the trip from Kingston to Montreal, in a day, provided she had to be locked through the Cornwall canal or the proposed lock on the American side. Strenuous objections have been raised by the interests in question against the project.

Sixth: The possible destruction of the proposed dam by natural forces, or by the malice of any evil-intentioned person (an earthquake might be the means of destroying the dam), certainly a very few pounds of dynamite in the hands of an intelligent man would be most disastrous. The volume of water which the dam would contain would be sufficiently great, if liberated in the form of a wave, to, at any rate, destroy the greater portion of the town of Cornwall; certainly the canal, or that portion of it below the dam; and without doubt, the means of flooding Lake St. Francis and a large section of the land on the river bank protected by the Hungry Bay dyke; besides unquestionably imperilling the Soulanges canal, as well as the villages fronting the river between Lake St. Francis and Lake St. Louis. Whether the effect of such a sudden break would be taken care of in Lake St. Francis and Lake St. Louis, is a question. Experience had on a very much smaller scale would lead one to expect that the damage would be continued on through the lower portion of Montreal, with the possible destruction of the Lachine canal, as well.

Seventh: The plans show a very small percentage of development on the Canadian side. We should judge that over eighty per cent is contemplated to be developed in the United States; and of course, this would be a very unfair distribution of the power in question. In any event, should the project receive consideration, considerable revision of the plans would have to be made, so as to secure a more equitable division of the power development.

Eighth: A vital point in connection with the whole scheme would be that all the plans of the dams, locks, etc., on the proposed works must be approved in advance by engineers responsible to Canada and to the United States, respectively, and upon which they must agree; the detail of the works in question should be passed upon by the joint approval of engineers from both countries. Whether this is a practical thing to secure we are unable to say, but it is obvious that the interest of Canada is such that no portion of the work in question could be allowed to be gone on with unless it received a most strict examination and inspection by engineers acting for this country. No doubt, the United States authorities would take a similar attitude with regard to the question, although their interests are trivial compared with ours, on account of the fact that they have so little land on the St. Lawrence below the power in question.

Ninth: No private corporation should be permitted to have under its control the regulation of the height of water in such an important river as the St. Lawrence.

We are, sir,

Your obedient servants,

M. J. BUTLER,
Chief Engineer, Department of Railways and Canals.

WM. P. ANDERSON.
Chief Engineer, Department of Marine and Fisheries.

EUGENE D. LAFLEUR,
Chief Engineer, Department of Publics Works, Canada.

APPENDIX 'B.'

PROCEEDINGS of public hearing, Toronto, January 26, 1909, on the project of the Cedars Rapids Manufacturing and Power Co., Development.

TORONTO, Jan. 26, 1909.

CEDAR RAPIDS MANUFACTURING AND POWER CO.

The following deputation appeared representing this company, which has headquarters in Cedars, province of Quebec:—

J. W. Domville, President; Casimir Dessaulles, solicitor; Henry Holgate, C.E., engineer.

Secretary Wilson read letter from Nap. Tessier, Secretary Department of Public Works of Canada, Ottawa, December 18, 1908, addressed to Mr. Coté, Secretary Canadian section, covering correspondence, reports and draft agreement in relation to the application of the Cedars Rapids Manufacturing and Power Company in reference to their proposed development work on the St. Lawrence river.

Mr. COSTE: I would like to make a little statement in reference to the Cedars Rapids so that our American friends will understand the question well. The Cedars Rapids Manufacturing and Power Company are acting under a charter granted by the Dominion Parliament in 1904. They then prepared their plans and filed them with the Minister of Public Works, and in January, 1906, the Minister of Public Works obtained an order in council authorizing his department to deal with the matter practically. That is, the order in council authorizes the company to go ahead subject to an agreement or a contract to be made with the Department of Public Works, and takes it out of the hands of the executive and puts it into the hands of the Minister of Public Works. The Minister of Public Works had an examination made of these rapids, and on the report of one of the engineers actually had a formal agreement drawn out, which is in the file, and put it to the company to sign that agreement, which would have given permission to go on. The company was not then prepared to go along with the work, and did not want to sign the agreement, so as not to make financing difficult. Nothing was done then from 1906 until October, 1908, when the secretary of the company forwarded an agreement practically in the same shape as it was before, but suggesting a few changes in it for the consideration of the Minister of Public Works. In December, 1908, the Minister decided, by the letter that the secretary of the department writes, to place the matter before the International Waterways Commission, on the ground, I suppose, that it was an international matter, since the Americans were interested in the navigation of the St. Lawrence.

CHAIRMAN GIBBONS: Gentlemen, the main point to be discussed is that involved in the principle adopted by the commission, that no interference is to be permitted which is injurious to the interests of navigation. If navigation interests are not affected injuriously, the policy of the commission is to permit these developments; but navigation has a prior right, so that that is really what the commission would want to understand about the matter. The citizens of the United States have, by treaty, the same right as we have to the use of the St. Lawrence through Canadian territory to the sea. That treaty is of long standing, and the American section as well as our own are in that way interested in anything that interferes with the navigation of the St. Lawrence.

MR. DESSAULLES: I have very little to add to what Mr. Coste said. We have brought the engineer of the company, Mr. Holgate, to give technical information on the works proposed to be done, which we hope will satisfy the commission that the navigation of the St. Lawrence cannot possibly be affected by the works. I fancy that Mr. Holgate is better posted than I am on these questions, and he will furnish any data or information on the lines suggested by the engineers of the commission.

MR. HOLGATE: I produce a plan made by the late Thomas Monro, who was chief engineer of the Soulanges canal. It embraces the whole of the Soulanges canal from Lake St. Louis to Lake St. Francis. The Soulanges canal comes out near the mouth of the Ottawa river.

CHAIRMAN GIBBONS: Is any other use being made of these rapids? Any other powers there?

MR. HOLGATE: No.

CHAIRMAN GIBBONS: How far are the Cedars Rapids from Montreal?

MR. HOLGATE: 25 miles.

CHAIRMAN GIBBONS: Do any vessels run here?

MR. HOLGATE: Some passenger boats run these rapids. Below the Cedars rapids are the Split Rocks and the Cascades. The Cedars rapids are the easiest of navigation of any of the rapids. Any difficulty that has existed—call it difficulty or not, there has been really no difficulty—but any trouble that has arisen in navigation has been either in the Coteau rapids or in the Cascades, where the water is lower at periods than it is in the Cedars rapids. We have no records of any trouble in the Cedars rapids from navigation. The limiting point of navigation in the Cedars rapids is at La Barrière, but there is plenty of water over there.

Mr. Coste: Do I understand you to say that the Cascades practically control the navigation of these rapids?

Mr. Holgate: Yes.

Mr. Coste: That is, that when the Cascades are at their lowest water the boats have to stop, while they still would go over the Cedars rapids?

Mr. Holgate: I don't think the boats have ever actually had to stop.

Mr. Coste: At low water, that is in September and October?

Mr. Holgate: Well, they have probably stopped occasionally, but I have no recollection that they did stop; but the trouble I refer to at the Cascades is damages—striking rocks and that sort of thing in the tortuous channel at low periods. The part we are most interested in is from Cedars village down to Pointe Du Moulin. That covers a distance of about a mile and a half.

Chairman Gibbons: Your works would of course lower the level of here (Isle aux Vaches) to some extent?

Mr. Holgate: It might possibly. I don't think that figures can show anything definite in regard to the matter at the present time. (Producing plan in blue print showing particularly the scheme of proposed power development). This is the nearest approach to anything that exists in the way of a correct plan. The proposition is to build a dike or embankment from Isle aux Vaches, at its eastern end, somewhat parallel with the shore, in the river, and places the power-house at the lower end of Pointe Du Moulin, having the intake or the head race between the north side of Isle aux Vaches and the main land. See plans annexed to this report, marked plan E-1059 and plan 44-1. Plan E-1059 shows the works as contemplated in 1903, and plan B shows generally the proposed power development as submitted to the commission.

Chairman Gibbons: What does your charter call for?

Mr. Holgate: Three hundred and fifty thousand gallons per second. It amounts to about 55,000 cubic feet per second. That is the maximum.

Chairman Gibbons: That is a large quantity.

Mr. Coste: What power will you develop from that?

Mr. Holgate: About 150,000 horse-power.

Mr. Coste: With a fall of what?

Mr. Holgate: 32 feet. The steamboat channel is shown here. The depths in the steamboat channel are marked on the plan—15 feet, 12 feet 7 at La Barrière.

Mr. Coste: What is La Barrière? A rock?

Mr. Holgate: Yes, I think it probably is the remains of this island from erosion.

Mr. Stewart: Is there more water over the chute?

Mr. Holgate: Yes, there is more water over the Chute than there is at La Barrière. These depths are in relation to low water in Lake St. Francis.

Mr. Coste: Do you get these depths from Monro's survey?

Mr. Holgate: Yes.

Chairman Gibbons: What do the Richelieu steamship people require for navigation?

Mr. Holgate: The actual draught is 5 feet 5, but they require 7 feet.

Chairman Gibbons: They run pretty close, then, to the channel?

Mr. Holgate: This is the low-water stage, Mr. Chairman. They have never had any trouble here at all. There has been no trouble in the Cedars rapids from navigation. If it were necessary La Barrière could be removed. That would increase the average depth, whatever you increase this.

Chairman Gibbons: What effect do you figure that will have upon the flow lower down—south? What would be the depth at La Barrière?

Mr. Holgate: It might reduce that at lowest water stage possibly a few inches, but less than a foot.

Chairman Gibbons: All the volume that you carry within your embankment is taken from this section (indicating north and west of Isle aux Vaches)?

Mr. Holgate: Yes.

Chairman Gibbons: 55,000 cubic feet per second is a very large volume of water, isn't it?

Mr. Holgate: One reason why it would not decrease the depth so much as might be thought is the change in direction of this water. This water now coming down from the west touches the passage to the north—(illustrating on plan)—

Chairman Gibbons: You take about one-fourth the flow?

Mr. Holgate: About one-fourth the flow, maximum.

Mr. Clinton: How much water have you north of Isle aux Vaches?

Mr. Holgate: I think, as near as you can get at, is 80,000 cubic feet passing between Isle aux Vaches and the north shore.

Mr. Clinton: If they allow only 50,000 to pass down below, there will be an additional 30,000 coming down here. (Indicating to the southeast.)

Mr. Holgate: The 80,000 that flows now through the channel goes down between Isle aux Vaches and Pointe des Cèdres, so that the 30,000 that would be left would be split, and a portion of it would go down to the north of Isle Aux Vaches and the other to the south of Isle aux Vaches. The practical question is, how much would it lower the water? From my conclusions I cannot see the possibility of lowering the water. It is something under one foot where it is possibly it would lower the water at the Barrière. The water flowing down here is of course regulated by the height of Lake St. Francis, (producing table showing the variation of water levels at the entrance to Lock 14 at Valleyfield). I prepared this table in order to indicate the maximum and minimum levels of Lake St. Francis for the past 50 years, to show, more than anything else, that the variations are not excessive, and that low-water periods are very, very seldom. In 1895 there was a lower water period than we have had for some time, and even that was not extreme; that did not interfere with navigation west. See tables attached to this report marked Table A, and Table B.

Chairman Gibbons: What would be the height of water at La Barrière at that time?

Mr. Holgate: 9 feet less 1·31, that is 7·70 ft. These water levels refer to a depth 1 foot higher than the lowest water level that we have found, because that period occurred after Mr. Monro had made this plan. So that in 1895 there was only a depth of 7·70 at La Barrière.

Chairman Gibbons: If you take off a foot, that would leave 6·70. The Richelieu people seem to be interested more than anybody else; do they know anything of this scheme?

Mr. Holgate: I don't know whether they do or not.

Mr. Dessaulles: I think they were fully aware some time ago.

Mr. Holgate: I think Mr. Monro, in putting the ship channel down here, purposely put it over La Barrière to indicate what the result might be if they took the ships there. I have reproduced Mr. Monro's plan precisely. As a matter of fact, from witnesses to whom I have spoken about it, persons who live in the neighbourhood, the ships do not go there, but swing in between Isle aux Vaches and Isle à l'Ail. Nothing uses these rapids that would draw anything like that much water, except these boats, and the actual water that they draw is 5·5 ft. but we are speaking of 7 feet of water. That low period has only existed once in 50 years, as shown by this table and should it occur again, if it is a menace to navigation, it must be provided for by some supplementary works.

Chairman Gibbons: I wish we had known about this matter as fully as we do now, for it would have been wise to have had the Richelieu people here to listen to what you had to say. That seems to be the only difficulty.

Mr. Clinton: Were they notified?

Chairman Gibbons: No, I don't think they were notified. I did not appreciate the proposition until now.

Mr. Coste: I asked Mr. Coté yesterday if he had notified any of the Richelieu people. He said he had not, because he did not know that the company were able to proceed. Mr. Stewart has been writing to the company for information of various kinds, and no reply having been received he didn't think they would actually be prepared to meet us to-day and for that reason the Richelieu people were not notified for to-day's meeting.

General Ernst: What soundings have been taken here?

Mr. Coste: There are no soundings taken in there except what you see on this large map.

Mr. Stewart: That survey was made under my direction. They were not able to navigate the rapids, and the survey boats couldn't go into them to take soundings.

Mr. Holgate: I have gone back into all the records I can find as to low water, and have made this record (referring to Table of Variation of Water Levels) We have ascertained low water, and we have fixed that low water point from established bench marks, and reference to the bench mark is noted on the plan here; and the detail sheet gives the system that was used in connection with the established bench mark which is checked, and I can say it is absolutely correct.

Chairman Gibbons (Referring to steamboat channel at La Barrière): It seems to be a blockade of the channel.

Mr. Holgate: I show it on the plan as Mr. Monro showed it on his plan; and if it exists and the commission find that that is the only obstruction to navigation, then I would say that that, being an obstruction, should be removed. The difficulty of removing that would not be so very considerable. I may say that in my study of the matter my ideas are very, very strong with regard to the principles that you have laid down. I would not dare to bring before you a matter that would imperil navigation in the slightest degree.

Chairman Gibbons: We feel that the interests of navigation are paramount and must be protected. At the same time the commission are quite anxious to allow these improvements when they can do so consistently with that principle. In the resolution passed at our last meeting the navigation interests were to have been notified of this meeting. It is unfortunate that that has not been done. Possibly I am to blame more than anyone else, for I have practically been away from home ever since. It would seem reasonable that they should have an opportunity to hear your case. They are the only other people interested, and the policy of the commission has been to give everybody interested an opportunity to be heard. I do not want to bring you back again, and if we had these plans someway or another the navigation people could be notified. Are you in immediate hurry for the work?

Mr. Holgate: I think so; yes. I would suggest that there are two ways of obviating this. One is the removal of obstructions; the other is the arrangement that was provided in the draft agreement made with the Minister of Public Works for raising the water in the steamboat channel by introducing other works in the river. That is a very simple matter; and the Minister of Public Works has already provided that should there be interference with navigation, those works shall be built so as to raise the water above the low-water stage, so that practically the low-water stage will have no chance whatever to exist.

Chairman Gibbons: The agreement states:—'1. That the said company will so construct the said works that the general navigation of the St. Lawrence river shall not be impeded or interfered with, and that the consumption of water shall not be so great or so affected as to in any way injure the navigation on the St. Lawrence river.'

Mr. Holgate: They mean the consumption through the power-house.

Chairman Gibbon: The agreement proceeds:—'2. That if at any time in the opinion of the Minister or of any engineer appointed by the Minister for that purpose, the navigation of the St. Lawrence has been injuriously affected by the said works, then the company shall at once construct and maintain dykes or dams of which the location and mode of construction shall be determined by the Minister.'

Mr. Coste: In that agreement they are compelled to build certain dams to close certain channels so as to bring up the level of the water. I think in that connection that it was well to have the low stage of water on the south shore of the river, so that if we made any recommendation we could refer it to that. If the water gets any lower than that point, then the company would have to raise the water by artificial means.

Mr. Holgate: I may say we don't have to wait till the water gets to that level for the work, because with a systematic record of the levels of Lake St. Francis we can see, ahead of time, when the level is going to be affected lower down in the river. That is quite clear from studying the elevations of Lake St. Francis.

Mr. Stewart: That would apply provided no improvements or no changes were made. If you had put in a dam it would change here, and then the levels on Lake St. Francis would not be any indication of what the level here would be.

Mr. Holgate: There is a relation.

Mr. STEWART: Not if you change the conditions. If you take this 50,000 feet coming out here it will not then pass over at this point (indicating on map).

Mr. HOLGATE: But the whole quantity must pass down to Lake St. Francis.

Mr. STEWART: The quantity will pass, but it will not show the high water.

Mr. HOLGATE: The main point is this—we are willing to bind ourselves down to this—that low water shall not be permitted below the elevation given on the plan.

CHAIRMAN GIBBONS: That shows how much at La Barrière?

MR. HOLGATE: That shows 9 feet.

CHAIRMMAN GIBBONS: You are willing to maintain a level of 9 feet there?

Mr. HOLGATE: There are with reference to Mr. Monro's figures. As I said before, the difference between Lake St. Francis and here is that one foot rise in Lake St. Francis we find at this point is about 1·31. That is pretty nearly the relation between the two levels; so that Mr. Monro's figures were taken at the 1 foot higher elevation of Lake St. Francis than I have worked from. Therefore his depths will be 1·31 generally less than shown on this plan. That is why I said a little while ago that at La Barrière it would be 7·70. The nearest sounding to the bench mark is 15 feet and 14 feet—one on each side. We would be willing that the depths there would not be less than 13·70 and 12·70 instead of 15 and 14.

Mr. COSTE: That is, you would practically lower the water by 1 foot?

Mr. HOLGATE: Practically, yes.

Mr. COSTE: That is, it might have that effect?

Mr. HOLGATE: Practically, yes. The channel can be kept intact by the works placed in the river between these islands.

CHAIRMAN GIBBONS: In dealing with these matters we have rather adopted the suggestion that works which may be needed under certain changed conditions should be constructed at the start. It is rather difficult to carry out any other plan, because works cannot be constructed in a day.

Mr. HOLGATE: Still, in the face of the serious doubt that these works would interfere with navigation, it would probably be a hardship to insist on the company spending a large amount of money which would be futile.

CHAIRMAN GIBBONS: That would mean a large amount of money, would it?

Mr. HOLGATE: It must mean a large amount of money.

CHAIRMAN GIBBONS: You don't propose to sell the entire quantity at once?

Mr. DESSAULLES: No; we are limited by the market. It may be years before the maximum is reached, and we would be paying interest on a large amount of money for work that perhaps may not be needed.

CHAIRMAN GIBBONS: Would you bring factories there?

Mr. DESSAULLES: We would bring factories there.

General Ernst: How high are you going to build that dam?

Mr. Holgate: 15 feet.

General Ernst: You think you are using all you need?

Mr. Holgate: I think up to the commercial limit we are.

Chairman Gibbons: Would a delay of a month be a serious matter for you just now?

Mr. Domville: It would make quite a difference to us. We are estimating to take now only 100,000 horse-power; after that we would be very glad to construct any works that would be required.

Chairman Gibbons: How many cubic feet would that require?

Mr. Holgate: 100,000 would take 40,000 cubic feet. The effect of this work can be ascertained almost instantly when the works are in, and the effect can be remedied by the works that can be placed in the river, so that I see no element of uncertainty in the question. There is no risk, at any rate, for the first year or the first five years, of any possibility of interference with navigation; and before that period expired the exact effect of the works would be definitely ascertained, and then this commission would dictate what works must be placed there to restore the channel that has been interfered with.

Mr. Dessaulles: Works might be built that would prevent the consumption of a certain amount of water if it is injurious, if it is found that the scheme would not be practicable beyond that. It might take more than five years; I suppose it would take two years before the works would start, and then it might take another five years after that.

Chairman Gibbons: Two years before the works would start?

Mr. Dessaulles: Start operating, yes.

Chairman Gibbons: When did you propose to commence the construction?

Mr. Dessaulles: In the spring, probably at once.

Mr. Domville: We are going right ahead on it.

Mr. Dessaulles: There are expropriations of land to be made, which we have the power to do under the charter, and it would be better that those should be started on at once.

Mr. Holgate: Work on the construction details has already begun.

Chairman Gibbons: It would seem to be a question of details at most. It does not seem to me that it should interfere with your general work. It is just a matter of convenience. I still do feel strongly that before the commission take action they should let the Richelieu people know, and hear what they have to say. We have had the same difficulty arising in that other proposition near Barnhart Island; the Richelieu Company bitterly oppose the works there. The plans are being altered. They are very strenuous in their opposition to that, as was also Mr. Calvin, who carried on a rafting business. It has been suggested that this channel you are closing is the channel now used in rafting. What would the effect on Mr. Calvin's rafting work by the closing of that channel?

Mr. Holgate: None.

Chairman Gibbons: There is plenty of room for them outside?

Mr. HOLGATE: Oh, yes, there is plenty of room. The floating of rafts down will certainly not be interfered with.

Mr. COSTE: I understand all the rafts pass on the north side of Isle aux Vaches and swing round here (illustrating). Now, if you close that, you could not bring them through this navigable channel. They get away at present from the navigable channel, and they come around this north way.

Mr. HOLGATE: They ultimately conflict with the navigation channel farther down the rapids, so it is not a question of keeping clear of the navigation channel—the steamboat channel—it is simply a matter of convenience in entering the channel above.

CHAIRMAN GIBBONS: How far is that around?

Mr. HOLGATE: Less than half a mile. The current coming from the north of Isle aux Vaches would be cut off then, and there would be no trouble in his making the same course as he always has below Isle aux Vaches. The only alteration will be the direction of entering the rapids.

Mr. DESSAULLES: And in fact sometimes they don't get the current, and they pass south of Isle aux Vaches. I have seen that myself.

PROF. HASKELL: If you are going to take 50,000 feet you are going to have a current that will suck in a raft on this side of it, unless some provision is made to take care of it.

Mr. HOLGATE: There are about 80,000 feet coming down here now.

PROF. HASKELL: 50,000 will give a strong current on the north side of this island (Isle aux Vaches).

Mr. HOLGATE: The river is broad here and speed is very slow, so that the alteration in the quantity will not affect the steering of the raft.

Mr. COSTE: The current is going to be diminished considerably in this channel.

PROF. HASKELL: Are you sure of it?

Mr. COSTE: You have a mile and a half of practically dead water here on the level (illustrating). Here you have 80,000 feet coming down now, dropping.

PROF. HASKELL: You are going to take 50,000 feet per second, and do you tell me there is not going to be any current there?

Mr. COSTE: There will, of course.

PROF. HASKELL: There will be a good live one.

Mr. STEWART: What is your width?

Mr. HOLGATE: 450 feet.

Mr. STEWART: What is your depth?

Mr. HOLGATE: About 30 feet. The question of current in the canal, however, does not enter into the rapids. It is the current west of Isle aux Vaches. I think Mr. Monro gives the speed on his plan here.

Mr. STEWART (After calculating): There would be 4 feet per second through that.

PROF. HASKELL: That is a pretty good current.

CHAIRMAN GIBBONS: That is pretty lively, isn't it'?

MR. HOLGATE: It is not too lively for maximum conditions at the head of the power channel.

MR. STEWART: Of course a raft has nothing to guide it. It is simply drifting down. It has no tugs to it.

MR. COSTE: It is a question of putting booms and boom-piers at their work across here to prevent their being drawn in (indicating space between Isle aux Vaches and north shore).

MR. DOMVILLE: In our original plan we have shown that.

MR. COSTE: The big current is to the west and east of Isle aux Vaches. If the dam is going to increase the current they will have to put booms in here.

MR. DOMVILLE: The plans filed by the government to-day show the boom here. The plans that we filed show that we have to erect a boom.

MR. HOLGATE: However, it was not on account of rafting; it was on account of ice.

MR. COSTE: The rafts follow the shore here. The way to look at it is this, that for a long time to come these people will not take the 54,000 of water, and if they were allowed to go ahead with their work, that the gaugers ought to be put there and see what the effect was of taking 10,000 and 15,000 feet, and the work would be done gradually.

CHAIRMAN GIBBONS: Their charter calls for the full amount. You have to deal with it as a whole.

MR. COSTE: The whole can be taken eventually, but the whole may entail the construction of some subsidiary works to raise the level of the water or the dredging of some spot to give the water to navigation.

MR. HOLGATE: That is what we would like.

CHAIRMAN GIBBONS: You speak of wanting 40,000 cubic feet at practically the start.

MR. DOMVILLE: We would not want as much as that at the start.

CHAIRMAN GIBBONS: I misunderstood you.

MR. DESSAULLES: I suppose the development would not be practical unless we started with a sale of 50,000 horse-power?

MR. HOLGATE: I think it divides itself into three stages of 50,000. It would not be commercial unless we developed 50,000 at once, at the start. We have already 50,000 we can dispose of, so we know where we are. The next addition would be 25,000 or 50,000 horse-power.

CHAIRMAN GIBBONS: That 50,000 represents how much in cubic feet?

MR. HOLGATE: Say 20,000. So what we would like would be to have the commission approve of the general arrangement, with some such stipulation as the Commissioner of Public Works placed in the agreement which he at that time was willing to execute on behalf of the Canadian Government; and if there is any other item that this commission thinks should be inserted to safeguard navigation, this company will agree to it.

General Ernst: I would like to hear you on the possibilities of development there, without reference to the present demand.

Mr. Holgate: The only other way would be to dam the whole river. You cannot combine the other rapids commercially with the Cedars rapids in making a development.

Chairman Gibbons: It comes, then, to what you say in your application, that it would take about 50,000 cubic feet.

Mr. Holgate: I think that is about the limit. The potential of these rapids, I think, is that 150,000 horse-power. I cannot conceive of any sensible arrangement for damming the river and using the whole river at that point. The over-flow area is not sufficient.

General Ernst: You think that will be true always, do you?

Mr. Holgate: At this point, yes. It would not do to dam the whole river at this point. It is not feasible here on account of the length of the over-flow, in fact the width of the river: it is not sufficient; the dangers that you would have up stream.

Prof. Haskell: You mean from back water?

Mr. Holgate: The back water would be a very serious matter.

Chairman Gibbons: Ice, too.

Mr. Holgate: Ice would be here a very serious matter if you were to attempt to dam the whole river. I have considered that matter, and have advised to abandon it.

General Ernst: Suppose you should wish to do it in future, how would these works be interfered with in any such scheme?

Mr. Holgate: It is a matter for study. I would not like to give an opinion just now. I think it is what you might call a remote contingency.

Chairman Gibbons: It would not interfere with your present use, would it?

Mr. Coste: There would be a loss of head in the whole chain of rapids, but with one particular rapid it would not interfere very much. The question would be similar to the question at the Soo. The river could be worked both ways—either by side diversions or by a complete dam across; that is, if the conditions of the ice and the flows are correct. But I agree with Mr. Holgate in this matter, that the ice conditions on that part of the St. Lawrence are such as practically to deprive it of the use of those rapids by a dam unless the whole of the St. Lawrence is made a series of pools.

Prof. Haskell: Does the ice ever block there at the head of those rapids?

Mr. Holgate: No, sir, the ice conditions are not bad here. They are all such that they can be met.

Mr. Stewart: The ice all comes down and blocks at the foot of Soulanges rapids?

Mr. Holgate: Yes.

Chairman Gibbons: The proposition seems feasible on the face of it as far as the power part of it is concerned.

Prof. Haskell: If that is the case with your ice blocks up there, do you see any objection to damming the whole river?—because if this were converted into a pool it would simply close over.

Mr. Stewart: It would not altogether be in the nature of a pool.

General Ernst: Would this contract enable the government to authorize the damming of the whole of the river later on?

Mr. Dessaulles: We would not have any power to build works right across.

General Ernst: But for this remote contingency of the future, suppose you get your works in operation and there is a demand for additional power some time in the dim future, would your contract prevent the Canadian Government from authorizing some other company or your company to utilize the rest of the water?

Chairman Gibbons: It would not prevent their authorizing them, that is sure.

Mr. Dessaulles: We have the riparian right. It would be a matter of expropriation.

Mr. Coste: The only contingency would be the damming of the power on the other side; then it is doubtful if they could get the water. They could not get the amount of water that would be required from this development to make it worth while to work.

General Ernst: What is the low-water discharge?

Mr. Coste: About 176,000, the lowest.

Prof. Haskell: It must be more than that. The low-water discharge of the St. Lawrence is some 225,000, isn't it?

Mr. Coste: From measurements made this last summer away down at Sorel, it was less than 200,000 after it gets the whole of the water in. It is very low.

Mr. Holgate: In 1862 it was 187,000.

Mr. Stewart: I think the table I have in the office from Mr. Rickey is 176,000.

Chairman Gibbons: How can it be so much lower than at Niagara?

Mr. Stewart: At Niagara the low water discharge is less than 200,000.

General Ernst: It is about 180,000 at low water discharge.

Mr. Holgate: That low-water I speak of was in the month of February, on account of ice conditions; so that as far as navigation is concerned my minimum figures do not apply exactly. I am only giving you a list upon minimum conditions; I understand they were in winter season when there was no navigation.

Prof. Haskell: If you take 55,000 as against 176,000 it would be a much larger proportion than if it were 200,000, if the low-water gets down to 176,000 in the navigation season.

Mr. Stewart: No, that is in February. August is a good level.

Chairman Gibbons: I am going to suggest to the commission that you leave these plans, and that the Richelieu Company and the Calvin people be notified that they are at the office of the commission in Ottawa, and that they be asked if they have any serious objection to this work under these conditions; and if they have, I suggest that we call a meeting of our commission promptly to deal with the matter. If they have no objection, we can deal with it, and go on the line that has been suggested. Is there any objection to that?

Mr. DESSAULLES: That appears fair enough. We don't interfere with navigation. If that is provided for, I don't see what the Richelieu Company can object to. Of course the matter was passed on by the government years ago.

CHAIRMAN GIBBONS: It has only come to us recently.

Mr. DESSAULLES: The plans were prepared then and the government Engineers—

CHAIRMAN GIBBONS: You see the difficulty we are in in dealing with that is, that they are the only people who are navigating this stream. We would like to hear what they have to say, because they are objecting to any use of it. Now, it seems to me it would save time if we were to communicate with them that this application has been made, and that the commission propose to deal with it, but if they desire to interpose any objection a special meeting of the commission will be called if they notify us. We will not delay the matter. We don't want to delay the work. They are the only people interested? Should we deal with it without hearing what they have to say?

Mr. DESSAULLES: As a matter of law it is not generally done.

CHAIRMAN GIBBONS: It is usual to notify the other side. Of course if there had not been any immediate hurry we would take the matter up at the next meeting of the commission, in about a month. I am trying to meet the desire of your people, and adopt this other plan. It may be that after they examine the plans they will see no objection. We will not hear them *ex parte;* we will notify you. We don't want to give them an opportunity of saying we dealt with this without giving them opportunity to be heard.

Mr. CLINTON: If the plans are left in Ottawa and the Richelieu Company are invited to examine them, ought there not to be a personal explanation by this company when they do examine them? They may go and examine the plans and not understand them.

CHAIRMAN GIBBONS: It might be simpler if the plans were left in Mr. Holgate's office, and we notified them that they are there with Mr. Holgate, and he will be very glad to explain them to the Richelieu people and Mr. Calvin.

GEN. ERNST: Are these all the plans there are? The agreement speaks about detail plains.

Mr. HOLGATE: We are supposed to furnish detail plans later on to the Department. The general plan was approved by an order in council.

Gen. ERNST: These are all the plans there are?

Mr. HOLGATE: These are all the plans there are at the present time.

CHAIRMAN GIBBONS: That would be sufficient for the Richelieu Company's purpose.

GEN. ERNST: Yes, but I don't see how we can approve the plans.

Mr. COSTE: We are not asked to approve the plans. We are called on to say that these works will not interfere with navigation if certain things are done.

Chairman Gibbons: The plans are approved entirely by the Minister of Public Works under the agreement.

Mr. Domville: We anticipate that there will be a certain amount of objection raised to our plans, and it would facilitate matters if you could arrange to have a meeting shortly on an appointed day, and we would all come up to any place that would be convenient to you; because if they go to Mr. Holgate we fancy there may be objections raised, and we will be helpless in the meantime. Would it be possible to have a meeting of the commission?

Chairman Gibbons: We anticipated all this, and understood that the parties should all be notified. A mistake has occurred, and the other parties were not informed of this meeting. We will have everybody notified and then deal with it.

Mr. Dessaulles: A day might be fixed.

Chairman Gibbons: We will not delay in any way, but I think, so that they should have a chance to be prepared, it would be well to tell them the plans are with Mr. Holgate in Montreal.

Mr. Holgate: Could you, in notifying them, put a limiting date on or before which they should inform us of any objections?

Chairman Gibbons: Yes; say within ten days of the receipt of the notice.

Mr. Coste: If you make an arrangement with those people I will go to Montreal on the date that you receive them.

Mr. Holgate: Thank you.

After the deputation had retired, the commission instructed the secretary of the Canadian section to inform the Richelieu Navigation Company and Messrs. Calvin of Kingston that the plans of the Cedars Rapids Manufacturing and Power Company can be seen in the office of Messrs. Ross & Holgate, Montreal, and requesting them to notify the secretary of said company within ten days if they have any objections to the proposed development. It was also decided that all parties in interest be notified that the matter of the Cedars Rapids Development Company will be taken up at the next meeting of the commission in Buffalo, and that they be notified to be present if they desire to do so on Friday, February 26, at 10 A.M., at the office of the American section in Buffalo, N.Y.

TABLE B.—STATEMENT giving the data used and the method f
of the St. Lawrence]

Date.		Elevation of Water on Gauge at Cedars Wharf.	Depth of Water on Sill of Lock 14, at Valleyfield.	
Year.	Day.			
1874....	May 20........	158·45	13·17	These elevations and depth to projects for a canal l But the foregoing short at the highest and low
1874....	" 21........	158·45	13·25	
1874 ...	" 22........	158·55	13·25	
1874....	" 23........	158·55	13·17	
1874....	" 24........	158·45	13·17	
1874 ...	" 25........	158·55	13·17	
1874....	" 26	158·65	13·25	
1874....	" 27........	158·45	13·17	
	Average....	158·53	13·20	
1872....	Dec. 26........	155·25	10·83	
1872....	" 27........	155·35	10·75	
1872....	" 28........	155·25	10·75	
1872....	" 29	155·15	10·67	
1872....	" 30	155·25	10·67	
1872....	" 31........	155·35	10·67	
	Average....	155·27	10·72	
Diff. of	Averages.......	3·26	2·48	These figures establish the lock corresponding to 3·
		Gauge on Cedars Wharf.	Gauge at Pointe Du Moulin.	
1904....	June 7.....	−0·40	−0·40	These readings give the f Rapids). 0·00 in each column repre + is rise above, and − is The readings were not tal The differences range fro the maximum differe This record fairly establi as at Cedars Wharf.
1904....	" 13....	−0·10	−0·15	
1904....	" 17....	−0·15	−0·10	
1904....	" 28.......	−0·15	−0·10	
1904....	Aug. 6.....	+0·15	0·00	
1904....	" 10...	−0·10	−0·20	
1904....	" 15...	+0·05	0·00	
1904 ...	" 19...	−0·20	−0·20	
1904....	" 24...	+0·05	0·00	
1904....	" 29 ...	−0·10	−0·20	
1904....	Sep. 5...	+0·45	+0·40	
1904....	" 10...	−0·35	−0·40	
1904....	" 14...	−0·15	−0·20	
1904 ...	" 22....	−0·45	−0·50	
1904....	" 27....	−0·55	−0·60	
1904 ..	Oct. 1...	−0·15	−0·20	The fluctuations at Cedar any point between will apply with reasonable a the foot of the rapids.
		Water Surface below B.M. opp. Foot of Isle aux Noix.	Depths on Sill of Lock at Valleyfield.	These readings were tak opposite the Cedars J of Isle aux Noix, was immediately alongsi field Lock. Low water at Valleyfield Applying the ratio of 1 to that point. 3·30′+2·20=5·50′, gives immediately alongsi Canal. See Plan 44-
1909....	Jan. 20 Noon..	3·21	11·17	
1909....	" 20 5 P.M..	3·25	11·17	
1909....	" 21 9 A.M.	3·42	11·17	
1909....	" 21 Noon..	3·29	11·23	
	Average....	3·29	11·18	

MONTREAL, January 25, 1909.

TABLE A—SHOWING the variation of watel levels at the entrance to lock 14 at Valleyfield.—Sill 141·00.

Year.	January.		February.		March.		April.		May.		June.		July.		August.		September.		October.		November.		December.	
	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.	High.	Low.
1858	155·25	153·50	154·67	153·92	154·50	153·50	154·25	153·75	154·33	153·83	154·67	154·17	154·92	154·25	154·58	154·17	154·33	153·17	154·17	153·42	153·92	153·25	154·50	153·08
1859	154·58	153·42	154·16	153·16	154·75	153·50	154·75	153·92	154·67	154·33	154·67	154·42	154·58	154·16	154·42	153·92	154·16	153·33	154·25	153·00	153·92	153·00	154·67	153·17
1860	155·00	153·33	153·83	153·16	153·83	153·25	153·75	153·33	153·67	153·33	153·75	153·50	153·92	153·33	153·83	153·50	153·92	153·33	153·67	153·01	155·50	153·01	155·00	153·33
1861	154·50	153·16	154·16	152·50	154·33	153·33	154·75	153·83	154·92	154·53	154·75	154·33	155·17	153·83	154·42	153·92	154·16	153·58	154·32	153·67	154·33	153·50	154·25	153·75
1862	154·83	153·50	154·25	153·67	154·33	153·33	156·00	153·42	155·00	154·58	154·42	154·16	154·42	154·00	154·25	153·92	154·00	153·50	153·67	153·32	153·50	153·25	153·58	153·00
1863	153·92	153·08	154·00	153·00	153·75	153·00	154·75	153·25	154·58	153·67	154·33	153·75	154·08	153·58	154·58	153·50	153·67	153·25	153·33	152·92	153·33	152·83	153·33	153·00
1864	153·67	152·33	153·67	152·83	153·33	152·67	154·08	153·08	154·33	153·83	154·33	153·92	154·00	153·67	153·67	153·33	153·58	153·16	153·42	153·16	153·83	153·00	154·42	153·33
1865	154·00	153·08	153·83	152·67	154·83	152·67	154·83	153·83	154·00	153·75	154·00	153·92	154·00	153·42	153·58	153·00	153·33	152·67	153·17	152·25	152·92	152·25	153·25	152·82
1866	153·33	152·42	153·75	151·67	152·92	152·00	153·67	152·67	153·42	154·75	153·83	153·17	153·42	153·25	153·67	153·25	153·83	153·16	153·42	152·92	153·83	151·83	154·00	153·25
1867	154·83	153·58	154·00	153·33	153·75	153·33	154·25	153·75	155·08	154·17	154·58	154·00	154·25	153·67	153·25	153·33	154·42	153·75	152·92	152·33	152·83	152·25	153·16	151·75
1868	153·42	152·16	152·58	151·58	153·25	151·67	152·92	152·42	153·25	152·25	153·16	152·83	153·08	152·50	153·33	152·50	152·83	152·42	152·58	152·00	152·75	151·92	153·42	152·16
1869	153·42	152·25	153·00	151·83	152·25	151·42	154·67	152·25	153·92	153·42	153·75	153·25	153·92	153·33	153·75	153·16	153·67	153·25	153·83	153·25	153·67	152·16	153·58	152·83
1870	154·58	152·67	154·42	153·33	153·75	153·08	154·75	153·42	154·67	154·16	154·42	154·08	154·33	154·00	154·16	153·67	153·83	153·42	153·92	153·16	153·67	152·92	153·58	152·83
1871	153·83	152·42	153·83	152·67	153·92	153·67	153·92	153·17	154·00	153·17	153·83	153·42	153·75	153·08	153·92	153·67	153·25	153·67	152·83	152·08	152·92	152·00	152·92	152·25
1872	152·42	151·83	152·00	150·58	152·00	151·00	152·67	151·33	152·42	152·08	152·42	152·08	152·67	152·25	152·33	152·08	155·33	152·00	152·42	151·83	152·58	151·83	152·67	151·67
1873	152·96	151·54	152·83	151·67	152·58	151·83	153·75	152·33	154·00	153·25	153·67	153·25	153·50	153·08	153·42	152·92	153·33	152·67	153·00	152·58	153·00	152·33	153·83	152·16
1874	154·00	152·75	154·67	153·42	155·00	153·50	154·08	153·17	154·33	153·75	154·00	153·50	153·83	153·08	153·83	153·08	153·25	152·75	153·00	152·54	152·92	152·33	152·75	152·00
1875	153·33	152·33	152·16	150·50	152·67	151·67	153·00	152·00	153·50	152·67	152·92	152·67	152·83	152·75	152·75	152·42	152·75	152·16	152·83	151·67	152·58	151·83	152·83	151·67
1876	153·00	152·33	153·33	152·42	153·08	152·08	154·75	152·67	154·75	154·16	154·58	154·00	154·75	154·00	154·16	153·67	153·92	153·00	153·92	153·16	153·33	152·92	154·16	153·00
1877	154·00	152·92	153·00	152·50	152·08	152·58	153·58	153·00	153·42	153·00	153·00	152·75	153·16	152·92	153·00	152·75	152·75	152·25	152·50	151·92	152·67	152·16	152·50	152·16
1878	153·75	152·16	153·00	152·16	153·42	152·83	154·58	153·08	153·75	153·16	153·42	152·92	153·42	153·00	153·50	153·00	153·83	153·00	153·92	152·92	153·33	152·83	154·25	153·25
1879	154·50	153·75	154·58	153·42	153·75	152·83	153·75	153·33	153·92	153·25	153·42	153·08	153·16	152·92	153·25	152·67	153·00	152·33	152·58	152·25	152·42	151·75	152·67	152·16
1880	153·00	152·42	153·00	152·67	153·42	152·67	153·92	152·75	153·83	153·00	153·42	153·08	153·25	152·92	152·92	152·25	152·83	152·00	152·50	151·83	154·00	152·08	153·33	151·83
1881	153·00	151·33	152·50	150·92	153·16	151·92	153·16	152·42	153·16	152·50	153·08	152·75	153·00	152·83	153·00	152·42	152·58	152·00	152·42	152·00	152·58	152·08	152·83	152·00
1882	152·92	152·25	152·75	152·00	153·75	152·92	153·83	153·25	153·92	153·00	154·00	153·58	153·83	153·42	153·75	153·33	153·42	152·83	153·00	152·67	152·92	152·25	153·00	152·00
1883	152·50	151·83	152·50	151·42	152·50	151·83	153·92	152·25	154·16	153·08	154·17	153·67	154·08	153·75	154·00	153·16	154·00	153·25	153·58	152·83	154·08	153·00	153·92	153·00
1884	153·83	152·33	153·50	152·83	154·75	152·83	154·58	154·00	154·92	154·00	154·00	153·67	154·00	153·50	153·58	153·25	153·67	153·17	153·33	152·33	153·92	153·83	153·83	152·58
1885	153·92	152·92	153·92	152·92	152·00	150·00	154·17	150·50	153·75	153·25	154·00	153·33	153·83	153·42	153·58	153·17	153·50	152·83	153·50	153·00	153·92	153·00	154·67	153·25
1886	154·92	153·67	154·67	153·67	154·42	152·83	155·75	154·00	154·50	153·83	154·92	153·83	154·00	153·50	153·83	153·25	153·33	152·92	154·00	152·58	153·58	152·42	154·16	153·08
1887	153·83	152·92	154·42	153·00	153·92	153·16	155·50	153·25	154·58	153·83	154·00	153·67	153·83	153·08	153·25	152·83	153·25	152·75	153·08	152·17	153·00	152·00	153·00	152·00
1888	153·92	152·83	153·33	150·92	153·00	151·00	153·50	152·83	153·33	152·92	153·17	152·75	152·92	152·75	152·83	152·50	153·00	152·42	152·67	152·17	153·17	152·25	153·00	152·42
1889	153·67	152·25	153·83	150·83	153·33	150·83	153·67	152·83	153·50	152·83	153·83	153·00	153·92	153·00	153·83	153·00	153·17	152·67	153·17	152·08	153·08	151·58	153·75	152·50
1890	155·17	153·33	154·00	153·00	154·25	152·92	154·33	153·75	155·17	154·25	154·67	154·00	154·50	153·92	154·00	153·42	154·00	153·25	153·83	152·92	153·92	153·25	154·17	153·25
1891	153·92	153·00	153·75	153·08	154·42	153·25	154·58	153·83	154·75	153·67	153·67	153·25	153·58	153·25	153·42	153·00	153·00	152·67	152·75	152·08	152·83	151·75	152·67	151·92
1892	152·58	152·00	152·08	151·08	152·33	151·42	153·83	152·25	153·17	152·25	153·58	152·67	153·92	153·00	153·83	153·17	153·42	152·17	153·00	152·58	153·42	152·25	153·42	152·17
1893	153·00	151·50	151·75	151·33	153·08	151·50	153·58	153·00	154·50	153·00	154·00	153·58	153·83	153·50	154·00	152·83	154·00	153·00	154·00	152·67	153·17	152·50	153·58	152·42
1894	153·58	152·42	153·00	151·67	153·75	151·50	153·50	151·67	153·50	153·00	153·92	153·25	153·50	152·67	152·83	152·33	152·83	152·33	152·83	151·83	152·83	151·83	153·00	151·00
1895	153·00	152·00	152·92	150·83	152·67	151·17	153·50	152·50	152·67	152·17	152·50	152·00	152·58	151·75	152·92	151·75	151·83	151·33	151·67	151·17	151·67	150·50	153·17	151·00
1896	152·67	151·33	152·83	152·67	152·33	151·00	153·83	152·25	152·75	152·33	152·67	152·25	152·42	152·00	153·17	151·83	152·17	151·50	151·83	151·17	151·75	151·00	152·00	151·08
1897	151·92	151·33	151·75	151·08	152·50	151·33	153·83	152·25	153·00	152·33	152·83	152·42	152·92	152·33	152·83	152·25	152·33	151·83	152·00	151·33	151·92	151·00	152·50	151·67
1898	152·33	151·83	152·67	152·17	153·58	152·25	153·00	152·42	152·92	152·58	153·00	152·50	152·75	152·08	152·50	151·83	152·25	151·67	152·25	151·50	151·83	151·33	152·33	151·75
1899	152·16	151·92	152·42	151·50	153·00	151·75	153·42	152·67	153·00	152·50	153·25	152·50	152·92	152·33	152·50	151·83	152·17	151·50	152·08	151·42	152·00	151·25	152·00	152·17
1900	152·50	150·67	152·92	151·83	152·42	151·67	153·50	152·25	153·25	152·58	153·33	152·42	152·83	152·42	152·50	152·16	152·42	151·92	152·16	151·50	152·58	151·42	152·50	151·75
1901	152·92	152·25	152·50	152·00	152·75	151·50	153·33	152·33	152·83	152·16	152·92	152·17	152·67	152·00	152·17	151·83	152·17	151·67	151·92	151·67	151·83	150·83	152·50	151·17
1902	153·00	152·16	152·33	150·83	153·50	151·16	152·58	151·58	152·58	152·08	152·58	152·16	152·67	152·42	152·75	152·25	152·58	151·75	152·33	151·75	152·16	151·33	152·33	151·42
1903	152·75	151·50	152·50	151·00	153·33	152·17	153·25	152·58	152·92	152·58	152·92	152·50	152·92	152·67	152·92	152·33	152·50	152·25	152·33	152·08	152·17	151·33	152·92	151·42
1904	153·00	151·58	152·42	151·75	153·67	151·67	153·42	152·75	153·33	153·00	153·42	153·08	153·25	153·00	153·17	152·83	153·00	152·75	153·00	152·33	152·67	152·00	152·42	151·67
1905	152·83	151·92	152·83	151·75	153·00	151·50	153·00	152·17	152·58	152·33	152·75	152·33	153·25	152·58	152·92	152·40	152·67	152·25	152·58	152·17	152·58	152·08	152·75	151·83
1906	153·08	152·50	152·75	152·17	152·67	152·08	152·67	152·17	152·58	152·17	152·58	152·33	152·58	152·33	152·33	151·92	152·25	151·67	151·92	151·58	152·17	151·17	152·50	151·58
1907	153·00	150·67	153·08	152·17	153·83	151·92	153·58	152·50	153·08	151·92	153·00	152·75	152·92	152·50	152·92	152·42	152·58	151·92	152·67	152·17	152·92	152·08	153·08	152·17
1908	153·50	152·05	152·83	152·00	153·92	152·08	154·17	153·42	154·50	153·58	153·75	153·42	153·67	153·33	153·42	152·92	153·08	152·50	152·67	152·00	152·25	151·83	152·17	151·67

R. & H
January 24, 1909.

TABLE B.—STATEMENT giving the data used and the method followed in fixing the level of low water at a point on the south shore of the St. Lawrence River opposite Cedar Rapids.

Date.		Elevation of Water on Gauge at Cedars Wharf.	Depth of Water on Sill of Lock 14, at Valleyfield.	—
Year.	Day.			
1874...	May 20........	158·45	13·17	These elevations and depths of water are taken from report of G. F. Baillairgé, C.E., dated Sept. 17, 1874, and relating to projects for a canal between Lakes St. Louis and St. Francis. The gaugings cover a period of about 20 months. But the foregoing short periods have been selected because they cover periods of several days of slight fluctuation at the highest and lowest stages during the 20 months.
1874 ...	" 21	158·45	13·25	
1874 ...	" 22........	158·55	13·25	
1874....	" 23	158·55	13·17	
1874.. .	" 24	158·45	13·17	
1874.. .	" 25	158·55	13·17	
1874 ...	" 26...	158·65	13·25	
1874 ...	" 27........	158·45	13·17	
	Average....	158·53	13·20	
1872 ...	Dec. 26.	155·25	10·83	
1872 ...	" 27........	155·35	10·75	
1872....	" 28........	155·25	10·75	
1872 ...	" 29........	155·15	10·67	
1872....	" 30........	155·25	10·67	
1872....	" 31	155·35	10·67	
	Average....	155·27	10·72	
Diff. of	Averages	3·26	2·48	These figures establish the relation between fluctuations at Valleyfield Lock and at Cedars Wharf:—2·48 feet at the lock corresponding to 3·26 feet at Cedars Wharf, or, in the proportion of 1 to 1·31.
		Gauge on Cedars Wharf.	Gauge at Pointe Du Moulin.	
1904 ...	June 7...	−0·40	−0·40	These readings give the fluctuations of water surface at Cedars Wharf and at Pointe du Moulin (at the foot of Cedars Rapids). 0·00 in each column represents the stage of water on May 30, 1904. + is rise above, and − is the drop below that stage. The readings were not taken each day, but the table includes all the days on which both gauges were read. The differences range from 0·00 to 0·15, being greater at Cedars on 6 days and at Pointe du Moulin on 8 days, with the maximum difference at Cedars. This record fairly establishes the fact that the fluctuations at the foot of Cedars Rapids are of the same amplitude as at Cedars Wharf.
1904 ...	" 13... .	−0·10	−0·15	
1904 ..	" 17... .	−0·15	−0·10	
1904 ...	" 28.. .	−0·15	−0·10	
1904 ..	Aug. 6.......	+0·15	0·00	
1904 ...	" 10...	−0·10	−0·20	
1904....	" 15...	+0·05	0·00	
1904 ...	" 19 . .	−0·20	−0·20	
1904....	" 24 .	+0·05	0·00	
1904....	" 29..	−0·10	−0·20	
1904....	Sep . 5..	+0·45	+0·40	
1904 ...	" 10..	−0·35	−0·40	
1904 ...	" 14	−0·15	−0·20	
1904 ...	" 22.. ..	−0·45	−0·50	
1904 ...	" 27...	−0·55	−0·60	
1904 ..	Oct. 1... .	−0·15	−0·20	
				The fluctuations at Cedars Wharf and at the foot of the rapids being of the same amplitude, the fluctuations at any point between will be of approximately the same amplitude, and consequently, the ratio of 1 to 1·31 will also apply with reasonable accuracy between fluctuations at Valleyfield Lock and any point between Cedars Wharf and the foot of the rapids.
		Water Surface below B.M. opp. Foot of Isle aux Noix	Depths on Sill of Lock at Valleyfield.	These readings were taken for the purpose of establishing Low Water Level at a definite point on the south shore opposite the Cedars Rapids. A point on the stone stable on Lot 13, owned by André Lefebvre, opposite the foot of Isle aux Noix, was selected, and the vertical distance from this point to Quiet Water Surface in the Small Bay immediately alongside was noted over a period of 24 hours, and corresponding readings taken on the sill of Valleyfield Lock.
1909....	Jan. 20 Noon..	3·21	11·17	Low water at Valleyfield Lock (9·50 feet on sill) is 1·68 feet below the stage (11·18 feet) of Jan. 20 and 21, 1909. Applying the ratio of 1 to 1·31 to 1·68 gives 2·20 feet as the height of surface at the bench mark above low water at that point. 3·30′+2·20=5·50′, gives the total vertical distance from the bench mark down to low water in the small bay immediately alongside the stone stable. This B.M. is 33·91 feet lower than a B.M. on Lock 13, Beauharnois Canal. See Plan 44-1.
1909....	" 20 5 P.M..	3·25	11·17	
1909....	" 21 9 A.M.	3·42	11·17	
1909....	" 21 Noon..	3·29	11·23	
	Average....	3·29	11·18	

MONTREAL, January 25, 1909.

ROSS AND HOLGATE, Engineers.

ollowed in fixing the level of low water at a point on the south shore
River opposite Cedar Rapids.

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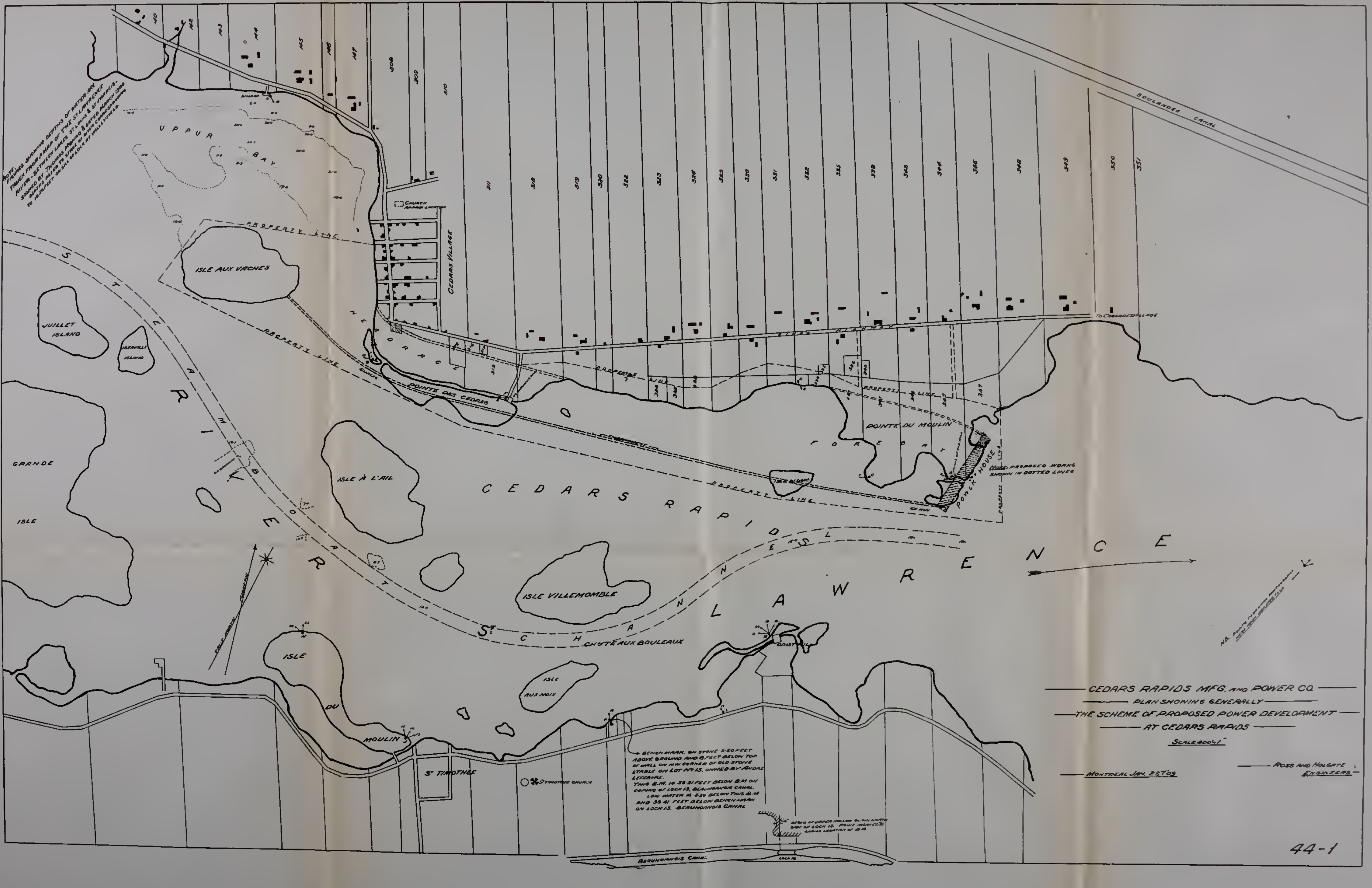
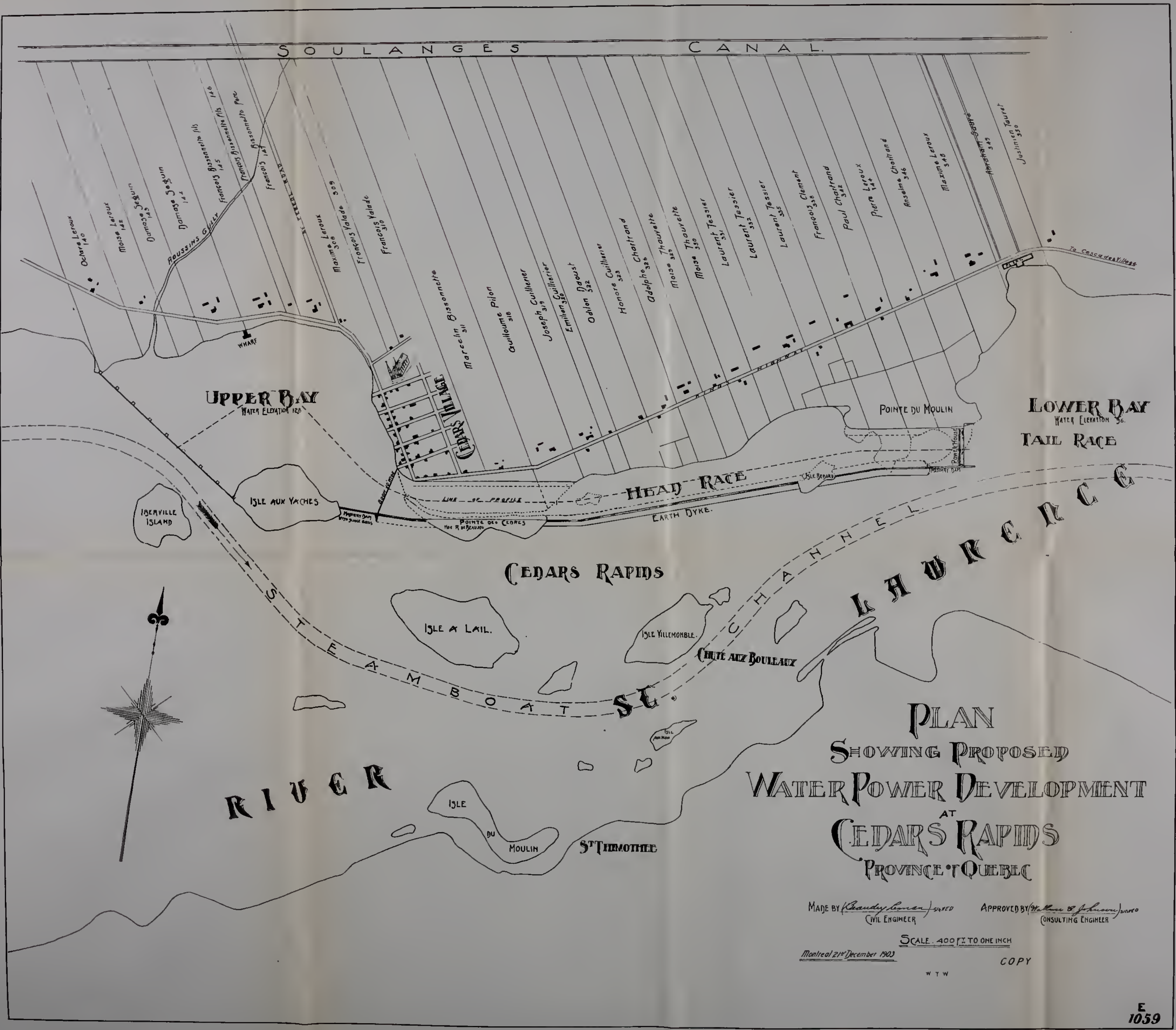
1.


CEDARS RAPIDS MFG. AND POWER CO.
PLAN SHOWING GENERALLY
THE SCHEME OF PROPOSED POWER DEVELOPMENT
AT CEDARS RAPIDS
SCALE 400'=1"
MONTREAL JAN. 22nd '09
ROSS AND HOLGATE ENGINEERS
NOTE. FIGURES SHOWING DEPTHS OF WATER ARE TAKEN FROM A MAP OF THE ST LAWRENCE RIVER - BETWEEN LAKES ST LOUIS & ST FRANCIS - SIGNED BY THOMAS MONRO & DATED MARCH 1900. DEPTHS REFER TO STAGE OF RIVER CORRESPONDING TO 10.50 FEET ON SILL OF LOCK AT VALLEYFIELD.
UPPUR BAY
ISLE AUX VACHES
PROPERTY LINE
CHURCH
CEDARS VILLAGE
JUILLET ISLAND
IBERVILLE ISLAND
GRANDE ISLE
POINTE DES CEDRES
HEADRACE
POINTE DU MOULIN
FOREBAY
POWER HOUSE
TAILRACE
NOTE. PROPOSED WORKS SHOWN IN DOTTED LINES
TO CASCADES VILLAGE
RIVER HIGHWAY
SOULANGES CANAL
ISLE À L'AIL
CEDARS RAPIDS
ISLE VILLEMOMBLE
ST LAWRENCE RIVER
CHANNEL
CHÛTE AUX BOULEAUX
ISLE DU MOULIN
ISLE AUX NOIX
GRIST MILL
ST TIMOTHEE
ST TIMOTHEE CHURCH
TRUE NORTH
MAGNETIC
BENCH MARK. ON STONE 2.60 FEET ABOVE GROUND, AND 6 FEET BELOW TOP OF WALL ON N.W. CORNER OF OLD STONE STABLE ON LOT No 13, OWNED BY ANDRE LEFEBVRE.
THIS B.M. IS 38.31 FEET BELOW B.M ON COPING OF LOCK 13, BEAUHARNOIS CANAL.
LOW WATER IS 5.50' BELOW THIS B.M AND 33.41 FEET BELOW BENCH MARK ON LOCK 13, BEAUHARNOIS CANAL
SIDE OF LOCK 13. POINT MARKED ⊕ SHOWS LOCATION OF B.M.
BEAUHARNOIS CANAL
LOCK 13
140
142
143
144
145
146
147
308
309
310
311
318
319
320
322
323
326
329
330
331
332
335
338
343
344
346
348
349
350
351
347
345
44-1



PLAN
SHOWING PROPOSED
WATER POWER DEVELOPMENT
AT
CEDARS RAPIDS
PROVINCE OF QUEBEC

MADE BY (Beaudry Leman) SIGNED
CIVIL ENGINEER

APPROVED BY (Wallace C. Johnson) SIGNED
CONSULTING ENGINEER

SCALE. 400 FT TO ONE INCH

Montreal 21st December 1903

COPY

W T W

E
1059

APPENDIX "C"

Public hearing on the application of the Cedars Rapids Manufacturing and Power Company to divert water from the Cedars Rapids in the St. Lawrence river, for power purposes.

Before the International Waterways Commission, at the office of the American Section, No. 328 Federal Building, Buffalo, N.Y., on Friday, February 26, 1909.

Present: Canadian Section: Louis Coste, W. J. Stewart.

American Section: Gen. O. H. Ernst, Chairman: E. E. Haskell, Secretary W. Edward Wilson.

Appearances: For the applicant, Cedars Rapids Manufacturing and Power Company: Henry Holgate, Casimir Dessaulles and James W. Domville.

For the Montreal Transportation Company: L. Henderson.

For the St. Lawrence and Chicago Steam Navigation Co: A. A. Wright.

For the Dominion Marine Association; Francis King,.

For the Richelieu and Ontario Navigation Co; C. J. Smith and George Batten.

For the Calvin Company, Ltd., H. A. Calvin.

Chairman Ernst: Gentlemen, the secretary would like to get the names of the gentlemen who wish to address us.

(Secretary Wilson takes names of the gentlemen who appear).

Chairman Ernst: Gentlemen, we will hear from the promoters of the enterprise, first; the engineer, Mr. Henry Holgate.

Mr. Holgate: Well, Mr. Chairman, we had the privilege of appearing before you a month ago and placed all the information before you then. Would it be just a review of that information?

Chairman Ernst: Have you your plans here? We will lay those out.

Mr. Holgate: Yes, sir. What I would say now would be simply a repetition, and take up the time perhaps unnecessarily.

(Mr. Holgate produces plans and places them on the table).

Chairman Ernst: These are the same blue-prints you had before?

Mr. Holgate: The identical blue-prints, gentlemen, just a duplicate of the blue-prints filed with the commission.

Chairman Ernst: It is possible that some of these gentlemen might wish to hear what you have to say, but we will defer that for the present, if you are satisfied, and let it come out at their solicitation.

Mr. Holgate: Just as you wish, sir.

Chairman Ernst: Unless you have something to say for their benefit.

Mr. Holgate: No, sir. I think I gave all the information that I could, at the previous meeting; but as you say, some of their remarks may call for further information. But I may read a brief description of conditions which I have put in writing, so that you may have my views in concise form. Under present conditions there is a flow of about 80,000 feet per second passing between Isle aux Vaches and Pointe des Cèdres. It is proposed to cut off from this flow 56,000 feet per second which eventually will be used for power development purposes, and the remaining 24,000 feet per second will be diverted, and will flow to the south of Isle aux Vaches joining the main channel of the river.

The low discharge of water from Lake Ontario in the season of navigation was in November, 1895, and was 184·847 cubic feet per second or say 185·000 cubic feet. This would be augmented by water reaching the river below Lake Ontario, so 190,000 feet may be taken as the low water flow here.

About 3,000 feet flows in the South channel, and the remainder or 187,000 feet would be in the main or North channel. Of this 187,000 there would be 107,000 feet flowing South of Isle aux Vaches, and 80,000 flowing north of the island.

Under changed conditions there will be 24,000 feet per second flowing between Isle aux Vaches and Grande Isle in addition to the present flow, the figures being 107,000 feet now flowing and 131,000 flowing after the completion of the power development and under their maximum operating conditions which means that the flow in this channel is augmented to the extent of 22½%.

The period of minimum flow of the river corresponds with the low water stage adopted by us, which is 9·50 feet on the sill of lock 14 at Valleyfield, and it will be noted that this condition only existed for a few days in November, when all passenger traffic had ceased on the river, and all navigation ceased by the 25th of that month.

The depths and levels shown on Plan No. 44-1 are based on a depth on Valleyfield lock of 10·5 feet which was minimum when Mr. Munro had his survey made in 1890.

It therefore follows that a reduction of depths and levels from those shown on plan No. 44-1 must be made to meet the new minimum conditions.

The relation of fluctuations of surface of Lake St. Francis and the waters in Cedars Rapids is established as shown on Table B to be 1: 1·31. (See page 747.)

Under existing conditions and using the new minimum there would then be 9·00—1·31, or say 7·70 feet of water over La Barrière.

La Barrière is the governing point in Cedars rapids for navigation.

Under proposed conditions there will be a greater volume of water flowing the channel between Grande Isle and Isle aux Vaches, this will deepen the water there to an appreciable extent and the effect of this deepening must extend some distance down stream and will increase the depth on La Barrière, but how much cannot be stated, at any rate it is safe to go as far as to say that the depth will be increased beyond a depth of 7·70 feet.

By consulting the figures on the tables it will be seen that the minimum depth was only reached once in fifty years during the season of navigation and this was only at the close of the season and was 7·7 feet.

The lowest in any October was.................. 8·6 feet.
" September was............... 8·8 "
" August was.................. 9·3 "
" July was.................... 9·3 "
" June was .... 9·8 "
" May was..................... 9·6 "
" April was................... 8·8 "

The next lowest November depth was 8·1 feet and only occurred once in 50 years, and the depth of 8·4 occurred twice.

The above all refers solely to the Cedars rapids, but as these are only a part of a succession of rapids, consisting of the Coteau, Cedars and Cascades, the real question lies in the consideration of the whole series of rapids, and as to whether the changed conditions will make the Cedars the limiting point for navigation.

The limiting depth of water in the channel in the Coteau rapids is less than 7 feet using the 1905 low water stage.

The limiting depth of water in the channel in the Cascades is 7·7 feet.

The Coteau and Cascades rapids will not be affected at all by the proposed development of power at the Cedars rapids.

The development of power to its maximum will not reduce the depth of water in the channel of the Cedars below a depth now existing in the Cascades or as low as a depth now existing in the Coteau rapids, so that it is plain the governing depth is in the Coteau rapids and will remain so and constitute the governing depth for the whole series of rapids.

Chairman Ernst: The Montreal Transportation Company is represented by Mr. Henderson. Is Mr. Henderson present?

Mr. Henderson: Yes, sir. I think, Mr. Chairman, that our intention was to have the counsel of the Dominion Marine Association, Mr. King, speak first to open our case.

Mr. King: With your permission, then, I would say that I appear for the navigation interests who are opposed to the present proposal.

Under ordinary circumstances we would ask to have the scheme definitely outlined for us now, but we understand that we are here at the invitation of the commission to set forth our objections, and we have had the opportunity of seeing the plans in Montreal. If, however, anything further develops different from what we have seen in the typewritten reports, we crave leave to have further opportunity to reply.

Allow me to say in the first place, that after investigation of these plans by the companies, individually interested, a conference took place in Montreal on the 22nd instant, attended by duly authorized representatives of the Dominion Marine Association, which represents practically all the navigation interests between Montreal and the head of the Great Lakes on the Canadian side, attended by the duly authorized representative of the Montreal Board of Trade, the French Chamber of Commerce, and the Shipping Federation of Canada, which represents the shipping from Montreal east and across the Atlantic; and at that conference unanimous expression of opinion took place in opposition to the present proposal. I have in my hand memorials from the Dominion Marine Association indicating their position, from the Montreal Board of Trade, from the French Chamber of Commerce, and I understand that the Shipping Federation has sent direct to your honourable commission their resolution; it has in some way missed us on the way; we are to have a copy of it.

If you will permit me, I think I can perhaps more shortly set forth the matter by reading the memorial and then I would ask opportunity to present the definite evidence which your commission desires from the practical experienced men in charge of the vessels which are principally prejudiced, the Calvin Company, the Richelieu and Ontario Navigation Company, including their chief pilot, who is absolutely familiar with this matter, and whom we have here; and the interests of the large freighters, package freighters and grain carriers who are so intensely interested in the freedom of navigation of the canals, represented by Mr. A. A. Wright, who was president of our association last year, and is superintendent of one of the largest fleets, and by Mr. Henderson, whose company, the Montreal Transportation Company, practically has the key to the shipment of grain in barges down to Montreal. I would read in the first place the memorial of the Dominion Marine Association, which is open to the criticism that it indulges in generalities, but we propose to back them up.

(Mr. King reads memorial of Dominion Marine Association, as follows:—)

To the Honourable
The Chairman and Members of
The International Waterways Commission:

The Memorial of

THE DOMINION MARINE ASSOCIATION

Humbly showeth:—

1. That in pursuance of the opportunity afforded by resolution of your honourable commission, your memorialists have caused careful examination to be made of the plans submitted by the Cedars Rapids Manufacturing and Power Company respecting their proposed works in the Cedars rapids, in the St. Lawrence river.

2. That the proposed works, if permitted to be undertaken, would very seriously interfere with the interests of navigation on the St. Lawrence, by diverting water from its present channels; by completely barring other necessary channels; by overloading and congesting the canal at this point; by entailing risk of accident in the proposed works and possible blockades and by causing derangements of present conditions, the consequence of which it is impossible for expert engineers or others to estimate with any degree of certainty.

3. That it appears that the proposed works would completely bar the river to the Calvin Company, Limited, whose rafts are obliged to take the channel now proposed to be closed; and that it also appears that the channel now available for certain boats of the Richelieu and Ontario Navigation Company, Limited, and others, will be materially altered, or rendered useless, while of course, no guarantee can be given that other equally satisfactory means of passing the rapids will be afforded.

4. That while engineers may be able to estimate the probable volumes of water, and the possible or even probable direction and velocity of currents, experience alone will give certain results, or settle the questions of grave importance whether proposed new channels will be safely navigable for the vessels requiring to use them.

5. That it has already been admitted that undertakings by power development companies, to meet future emergencies, and to protect or indemnify navigation interests, should not be accepted, and that the protection should be applied before the development is permitted.

6. That your memorialists have a larger duty to perform than merely to protect the interests of the two companies above named, and that their cases are cited merely as concrete examples sufficient in themselves to warrant refusal of sanction for the proposed works, without reference to the other dangers and difficulties entailed, such as the congestion of canals, the risk of accident to the works and the chance of blockades, not to mention the various other perils which can only be foreseen with reference to other cases where navigators are proved to have suffered by the positive evidence of increased insurance rates.

7. That your memorialists beg leave to refer to various previous memorials and petitions submitted to your honourable commission, in which they have, through their individual bodies, declared themselves unalterably opposed to power developments on the St. Lawrence and other rivers which may in the present or future possibly interfere to any extent with any navigation interests, and craving leave also to refer again to the well-defined policy already laid down by your honourable commission that the interests referred to are to be considered paramount, your memorialists hereby humbly submit that it is abundantly

apparent that these interests will be directly and definitely prejudiced and interfered with by the proposed works, and that the rights of navigators will also be rendered liable to the other indirect perils and difficulties referred to, and that therefore the plans submitted cannot be properly given the sanction for which the promoters ask.

Your memorialists therefore humbly pray that the plans and proposals submitted be not sanctioned by your honourable commission.

And your memorialists, as in duty bound, will ever pray.

Signed at Montreal, this 23rd day of February, 1909.

THE DOMINION MARINE ASSOCIATION,

By C. J. SMITH,
President.

FRANCIS KING,
Counsel.

The following resolution from the Shipping Federation of Canada was read:

Whereas, this Federation have examined the plans of the Cedars Rapids Manufacturing Company in regard to their proposed works at Cedars rapids, River St. Lawrence, and have also had the opinions of practical men who navigate the river at these parts, and gather from them that the proposed dam would change the current at the lower end of Isle Villemomble, besides, reduce the volume of water that is now required to carry vessels and rafts safely over the rapids, and have also read the report of the proceedings of the public meeting of the International Waterways Commission held at Toronto on the 26th January last; Be it resolved; That the Federation are of the unanimous opinion that said works would be generally detrimental to the interests of navigation, by preventing the larger steamers and rafts from navigating the Cedars rapids, and would require them to use the already congested canals, and that the Federation respectfully urge the International Waterways Commission to refuse to grant the application of the Cedars Rapids Manufacturing and Power Company's present scheme.

HUGH A. ALLAN,
President.

THOMAS ROBB,
Secretary.

Then, Mr. King read the memorial of the Calvin Company, as follows:

MEMO of objections submitted in support of Dominion Marine Associations Memorial *re* Cedars Rapids Manufacturing and Power Company Development.

The Calvin Company object to the proposed power company because it would completely shut them out from the use of the river at this point. All the rafts pass between Isle aux Vaches and Pointe aux Cèdres. Rafts cannot be safely navigated via Chute aux Bouleaux.

At rare intervals rafts have been driven to the south side of Ile aux Vaches, but are invariably deserted by their crews, and allowed to go through the rapids with more or less breaking up of the rafts.

We have no hesitation whatever in stating that the damming of the river at this point means that there will be absolutely no raft navigation of the river in the future.

This would mean that the rafts would have to be made up of a size suitable for navigating the canals, and the present yearly volume of rafting would mean 250 to 300 lockages per year, which would seriously delay and inconvenience other craft using the canals.

The Montreal Transportation Company and other package freight and grain carriers using the canals, object to this power scheme on the grounds that it will divert rafts and passenger steamers now using the natural river channel, into the canals, and in this way increase the traffic and congestion in the canals without increasing the volume of business down the St. Lawrence river.

In view of the present increased tonnage down the St. Lawrence, which necessarily will have to use the canals, we do not think that any steamers or rafts or floats which can now use the open waters of the river, should be diverted into the canals, but that the canals should be reserved for the increased traffic which we expect to create between Montreal and the lakes.

We draw attention to the fact that the average time taken by tows and steamers in passing through the canals has increased 20% to 25% in the last few years on account of the increase in tonnage, and if rafts and passenger steamers are forced into the canals in addition to increased tonnage the time required for canalling will be very seriously affected.

Steamers on the Ottawa river where the rafts use canals, are sometimes delayed six and eight hours, which will illustrate the effect of bringing rafts down the St. Lawrence canals.

The insurance rates on vessels using the St. Lawrence canals are now 1% higher than tonnage running to lake and upper points, and will be further increased if these vessels now using the river are forced into the canals.

The Richelieu and Ontario Navigation Company and other passenger and market Steamers state the following.

The opinion of our gilots is that if a dam is built from Ile aux Vaches to Point des Cèdres it will increase the velocity and change the direction of currents, tending to throw the steamer to the southward and into shallow water at La Barrière.

It is at present very difficult to navigate vessels past Ile Villemomble and through Chute aux Bouleaux, and the currents at present at Ile Bédard (known to pilots as Hog Island) enable them to straighten steamer out and keep her on her course.

So far as can be judged, the proposed dam which cuts through Hog island (Ile Bédard) would have the effect of making it impossible to take steamers through these rapids. This can be explained by our pilots on the plan made up by the power company.

In past years the steamer *Columbian* has been ashore in these rapids, the *Barge No. 81* got into trouble at Ile Bédard, and the Steamer *St. Hélèene* was lost between Ile Villemomble and Ile Bédard.

In addition to the Calvin Company and the Richelieu and Ontario Navigation Company, these rapids are navigated by the Ontario and Quebec Navigation Company, the Valleyfield-Montreal Market Line and the Cornwall Navigation Company's steamers.

Life and safety of passengers is the paramount consideration, and we have only been able to bring our boats up to the present maximum size and draught, and navigate the rapids safely from 50 years of experience and study by our pilots.

The volume of traffic on the large boats coming down as far as Prescott necessitated the building of much larger boats for the rapids, and we have spent in the last four years half a million dollars constructing boats as large as the rapids and canals would accommodate to take care of this traffic, and any material change in the depth of water or currents would put these boats out of commission, as they have been built to suit existing conditions.

There is barely time to run through the rapids with these fast steamers under present conditions; that is, steamers leave Kingston between 5 and 6 in the morning, connecting at Prescott with the rapids steamers, which arrive at Montreal between six and seven o'clock, and if we are obliged to use either the Cornwall canal, owing to the Long Sault Rapids Power Development scheme, or the Soulange canal, owing to the development of this Cedars rapids scheme, we will be unable to maintain our service.

These rapids are possibly the strongest attraction for tourists' travel to Canada, and this tourist travel has steadily increased, and is still increasing, until now upwards of 60,000 to 80,000 passengers yearly shoot the rapids.

The life and future of our company depend upon the maintenance of our through service, and any obstruction to the free navigation of the St. Lawrence river will practically ruin the business which has taken fifty years to build up.

The beautiful rapids of the St. Lawrence river as a national heritage to the people of the Dominion of Canada, and as no man, whether expert or layman, can tell what will be the ultimate effect of such work, we respectfully submit that the commission should not sanction any scheme which may affect their free navigation.

The power company call our attention to the fact that they will sign an agreement to build such works as necessary to preserve the stream as a navigable river should their works affect it, but what would we do while such works were being constructed?

It has also been agreed by the commission that such undertakings are unsatisfactory and should not be accepted; and that the risk of prejudice to navigation interests should not be permitted.

THE DOMINION MARINE ASSOCIATION,

By C. J. SMITH,
President.

FRANCIS KING,
Counsel,

Perhaps I might leave that to be elaborated by Mr. Smith and Captain Batten. The point which will be brought out with reference to the plan, more accurately, is this: That although they may divert more water into the main channels south of the proposed dam, and may argue that thereby you are increasing the flow and increasing the facilities for freight navigation, a navigator will answer at once that you cannot estimate the results and that a vessel must depend upon currents proved by experience to be absolutely necessary for safe navigation, otherwise she may never risk passage down through there at all. Only by fifty years' experience has the company reached the stage where they can run vessels down there, by testing this way and that way, for no one has made soundings of these rapids. It will be stated by this pilot that the only way they can get through the rapids down there at the present time is by depending upon the current and they will port the helm hard-a-port at one point, and with a ten foot rudder, and be absolutely helpless unless he strikes the current to give him a change in his course.

I would like, in filing these documents, to add the one submitted by the Montreal Board of Trade, which, after a simple preamble, goes on to say that the Board of Trade is not averse to the development of power, water-powers on the River St. Lawrence, provided that in granting the rights for such development, the paramount importance of navigation interests is recognized and that those interests are fully safeguarded.

(Mr. King reads resolution adopted by the Montreal Board of Trade, as follows:—)

THE MONTREAL BOARD OF TRADE.

MONTREAL, Feb. 24, 1909.

Montreal Board of Trade, Incorporated 1842.

THOS. COTÉ, Esq.,
Secretary International Waterways Commission, Canadian Section,
Buffalo.

SIR,—Referring to your letter of 5th instant with regard to the application of the Cedars Rapids Manufacturing and Power Company to be authorized to divert water from the Cedars rapids in the St. Lawrence river, I beg to enclose copy of the resolution adopted by the council of this board after consideration of the matter.

The council decided that there was no object in its being represented at the meeting of the commission, as all that it could say is embodied in its resolution.

I am, sir, your obedient servant,

GEO. HADRILL,
Secretary.

RESOLUTION adopted by the Council of the Montreal Board of Trade at meeting held on February 24, 1909.

RESOLVED, that the council of the Montreal Board of Trade has considered, as requested by the Canadian Section of the International Waterways Commission, the application of the Cedars Rapids Manufacturing and Power Company to be authorized to divert water from the Cedars rapids in the St. Lawrence river, and has by the courtesy of the engineers of that scheme studied the plans of the proposed works and received from the said engineers full explanations of the same,—

That the Board of Trade is not averse to the development of the water-powers on the River St. Lawrence provided that in granting the rights of such development, the paramount importance of navigation interests is recognized and that those interests are fully safeguarded,—

That the main objections to the proposed scheme are raised by the navigation interests who state that the probable lowering of the water on the north side of the river, which has always been used by rafts, might seriously affect the rafting business, and further, the possible effect on steamer navigation of changes in the cross currents at the lower end of Isle Villemomble; and therefore

That the council of the Board of Trade respectfully submits to the International Waterways Commission the necessity for exact information on these two points being procured prior to a decision being arrived at upon the application of the Cedars Rapids Manufacturing and Power Company, to be authorized to divert from the Cedars rapids.

Certified a true copy,

GEO. HADRILL,
Secretary.

The resolution of the French Chamber of Commerce, which I shall not attempt to read, as I am not a Frenchman and it is written in French, which I may say recites the appointment of a delegation to attend the joint conference in Montreal, their complete acceptance of the memorial of the Dominion Marine Association and the complete endorsement of that memorial by the council of the French Chamber of Commerce.

Then I would ask, if it is the wish of the commission, that Mr. Calvin, should be heard now to give his experience in regard to the raft business.

Mr. Calvin: Mr. Chairman and gentlemen, I do not know that I have anything to add to the short written statement that Mr. King has read. This is the channel that we have been using between Isle aux Vaches and Point des Cèdres, and I might say that we have been using that since 1825. Surely we ought not to be shut out now. That is a considerable length of time. We have had timber passing down there season after season without intermission since the year 1825, and I think so far as the navigation of that part of the river by raft is concerned, that we ought to know what we are talking about; and as I have said in the statement already made, once in a great while, perhaps once in a season, perhaps not oftener than once in two or three seasons, a north wind or a northeast wind will drive a raft that is floating down there, drive it around on to the south side of Isle aux Vaches, but in that case when the men on the raft see they are going that way they get ashore and allow it to come down through unattended.

Commissioner Stewart: Where does it go?

Mr. Calvin: Down the steamboat channel. And if by luck they can come pretty close to Isle Villemomble, or they come this way near Isle aux Vaches, if it comes close it might come down without hitting; it is more likely to go through the chute than elsewhere, because the biggest part of the water is down that way, and if it goes that way it goes all to pieces. This dam here I take it is put there so as to raise the water here. The result will be that the water down here will be lower than it is now. Well, this rub down through here, down this way, the channel comes pretty close to Isle à l'Ail and fairly close to this island, it is comparatively shallow water, comparatively near to Isle à l'Ail, and close to Isle Villemomble, and so on down, and when we get down pretty well past Isle Bédard down towards this point we come into the steamboat channel, and from that on down through the Split Rock and Cascade the channels are about identical. Along here (indicating on diagram) is shallow water; no steamboat can come there now; the water is shallow, it is not safe to navigate; but there, rafts can come through, but they rub the bottom occasionally, it is not an unusual thing; it is the usual thing for a raft drawing three and a half or four feet to rub, so that any shutting of water off here is going to stop, because men won't go down that way. I don't think there is anything to that. I have been down there personally myself with rafts hundreds of times; I know the river like an open book; I am not talking from somebody else's experience, or from what has been told me by the pilot, I have been down there myself hundreds of times, and I know very well that when that dam crosses there, that rafting down the river is finished.

Commissioner Stewart: Would the new condition here bear on the rafting through that channel?

Mr. Calvin: Here is an immense volume of water going to be shut off. That is the water that carries us down. That water would go this way; it is going to set further south; I think more than half the river goes through there. It seems to me there is an awful volume of water going through there; there is a terrific current through there north of the island.

COMMISSIONER COSTE: Have you any statute rights on the river?

Mr. CALVIN: I do not know. I may have. I fancy the public has rights on the river. I am not a lawyer. It strikes me that the river belongs to the people.

COMMISSIONER COSTE: There are certain rivers which under the statute are termed navigable and floatable rivers. I wanted to know whether you knew whether the St. Lawrence was.

Mr. CALVIN: I am not a lawyer.

COMMISSIONER COSTE: You might know that without being a lawyer. Do you know that, Mr. King?

Mr. KING: I do not want to beg the question. I am not aware of the existence of a statute. I would say at once that such rights would not necessarily depend on statute. Mr. Calvin's rights, which have existed since 1829, are such that any commission would desire to protect.

COMMISSIONER COSTE: I merely asked the question. It might strengthen Mr. Calvin's position.

Mr. KING: I do not know of any statute.

Mr. CALVIN: I am not a lawyer. I come before the commission asking for fair play.

COMMISSIONER COSTE: There are such things in Canada as a special Act of Parliament making rivers navigable and floatable in certain cases, such as the Ottawa and St. Maurice river, that the lumbermen have certain specified rights on them, the right to navigate with their rafts on these rivers. I merely ask for information whether such a clause refers to the St. Lawrence, which would give Mr. Calvin the absolute right, irrespective of what has been done for the last fifty or seventy years?

Mr. CALVIN: Eighty-four years.

Mr. KING: The answer I would give is, it applies to such other navigable and floatable streams of such small character that one could hardly suggest that—

Mr. WRIGHT: I might say on that point that there is in Canada what is known as the Rivers and Streams Bill. I have been in the lumber business 25 years before I had anything to do with the vessel business. That has been carried to the Privy Council. It was originally a dispute between two lumbermen as to what constituted a floatable stream, and it has been held by the Privy Council as the law in Canada that any stream down which logs can be driven is a floatable stream and is free to any one.

CHAIRMAN ERNST: Mr. King, will you suggest the name of the next speaker?

Mr. KING: I would like the Richelieu and Ontario Company to follow, as that is a more specific case. Mr. Smith.

Mr. SMITH: Mr. Chairman, in the memorial which has been presented, you have our general objection. At the previous meetings at which we have attended, the commissioners have suggested to us that we either bring engineers to support our contentions, or pilots. So far as our company is concerned, it is not an engineering problem with us. We feel that the burden of proof should be on the people applying for the privileges which we enjoy. But that we should present to you practically views by the men who are handling our steamers and who are known as river pilots, and whose experience is what we go on and our steamers have been built for years on their recommendations. I have brought with me Captain Batten, our chief pilot, who has been in our service for thirty-five years and is in command on that division, to talk to you in pilot's language as to how he navigates the Cedars. I do not know that I can say anything further excepting that our desire is, if any power schemes can be developed without injury to navigation interests, it is certainly to our interest to see them developed, because we are in the transportation business, both freight and passengers, and power companies along our route would increase our revenue and we would be very glad to see them located provided they could be so located without injury to the different interests. I would therefore simply suggest that we rest our case on the memorial presented to the Dominion Marine Association, and I would like you to hear Capt. Batten as to his objections, and how he navigates that portion of the river.

I would also like the privilege of recalling a conversation at our previous meetings as regards canalling. I was asked whether in the Long Sault development, provided we had to go through the canals, if I couldn't get to Montreal the same day. We have shown and set forth in our memorial that in order to get to Montreal by daylight, which is absolutely necessary, that we have to leave at five or six o'clock in the morning, and even then it is very difficult at times, with head winds or heavy weather, and we frequently miss the connection. To do that at the present time we run the Long Sault in thirty-five minutes. The present canal regulations would force us to take three hours. Those are the time limits that we can go through the canal, and I do not think if they shortened that time limit that we could operate in less. As to our time card in canalling after our years of experience we amend that time card from year to year, according to new conditions and changes. Our time card running the canals west bound lengthen out as I say from year to year to take advantage of practical experience, and will vary anywhere from three to five hours. There is no guarantee that you can maintain the time card of the canal. Therefore to force the Richelieu boats to go in any of the canals would cut out our rapids business entirely; in fact, if we were obliged to go through the Montreal canal on account of the Long Sault or the Soulanges on account of the Cedars, our boats would not get into Montreal that night at all.

Captain Batten may bring out the depth of water there; I presume he will; but in looking over the report of the proceedings held at Toronto January 25, it was stated by Mr. Holgate—this is just in general, I may be wrong; but as I infer, it says that the Richelieu boats draw five foot five. Certain of the Richelieu boats draw seven foot five. In fact, we haven't got a boat to-day, that is, of the new boats, than can operate on five feet five water.

COMMISSIONER STEWART: The ones that are operating through the Cedars?

MR. SMITH: They draw anywhere from seven foot to seven foot five and six.

CAPTAIN BATTEN: You cannot run a boat with the amount of water she is drawing.

MR. SMITH: The draught is seven feet six; depends on conditions. The steamers that we ran 15 or 20 or 25 years ago, small steamers, drew less water, but the steamers we are running to-day, as I say, we have brought them up by experience to their maximum and these steamers are built on draught and what we might call freak construction, but they are just built purely and solely for that business on our experience of 50 years, and to change the existing conditions naturally would affect those steamers, because they have been built to operate under the conditions which did prevail and which we understand are within our rights. I understand there is some question to be brought up as to whether these streams are navigable. As far as we are concerned, they are navigable.

COMMISSIONER STEWART: In what way?

MR. SMITH: A navigable stream is a stream that you can navigate, and we do navigate it. Boats have gone up the Long Sault rapids on the south shore.

COMMISSIONER STEWART: Oh, they go up the south channel?

COMMISSIONER COSTE: I understand, Mr. Smith, that Mr. Holgate's statement as to the draught of your vessel was taken from your own evidence in the Long Sault rapid investigation.

MR. SMITH: As I say, I may have said that our boats drew five foot five. If I did, I beg to correct the statement. That was the old *Prescott*. I am not a practical navigator. As Capt. Batten says a boat that is drawing five foot five, she would draw more water when loaded and under certain conditions, winds, coal and trim.

May I ask that Captain Batten be heard and that he go over the plans the same as Mr. Calvin did, and note his objections.

CAPTAIN BATTEN: Mr. Chairman, and gentlemen, I would like to just point out on the plans. I don't know that I can say anything that would give you any information.

MR. KING: Perhaps you might indicate to the commission the channel now taken by your boats. In referring to any location on the plan, name the location so that the stenographer may take it down in his notes; name the island or channel.

CAPTAIN BATTEN: Those French names we cannot pronounce. We call this Cow Island. This is supposed to be the steamboat channel now marked on the plans. Of course that runs pretty straight to what we really run. Here is the way we come açross here. We head on this island, this Isle aux Vaches; we head on that; of course we have certain marks down here we steer.

COMMISSIONER STEWART: Are there two islands there, or only one?

CAPTAIN BATTEN: Two.

COMMISSIONER STEWART: There are two on the ground, are there?

CAPTAIN BATTEN: This water comes down there. I never noticed the division there. There is another small island up here, but the water comes down through here. This is the place here that you haven't got much time to look around to find out what to do, navigating around through the rapids and out in the river is two different things; we come down here, the current strikes us and swings out here; you put your wheel over and we swing down, and cut over and come down opposite this island Isle à l'Ail, when we get here we are heading on the south island and the current sets us in. That is just probably wide e ough for us to get through, it is all we can do; we can go slow there, check the boat through there. I have touched on that several times, if the wind blowed hard from the south, it is almost impossible to get through without touching.

Commissioner STEWART: Have you ever touched on the south side?

CAPTAIN BATTEN: Yes, touched the stern.

MR. KING: Touched on both sides?

CAPTAIN BATTEN: Yes. A boat drawing seven feet two of water, you take a wind, you come in the shelter of the island, the wind catch you and you list, your bilge is down eight feet and a half on a flat bottom boat.

Mr. King: These boats are all built with the least possible draught?

Captain Batten: Yes, sir. And she would list coming around here. In here this is all shallow water. I was on there five weeks and I know it all around there; spent my holidays in the fall of the year. Out here it is shallow water. All along here south of the channel we depend on a current to drive us in here, to bring our stern out here. When we get past that main land, this is the Chute aux Bouleaux down here, coming down here is where the stern don't follow the bow; you go down sideways.

Mr. King: Approaching the Chute aux Bouleaux?

Captain Batten: Yes sir. Steering it going down that way, you have got her on full speed; here they say there was lots of deep water; we struck there twice last year with high water. If that was a place you could take her down and go slow, you might not touch, but shallow water and you running full speed, this displacement puts the water out and lets your boat down, but it is impossible to check there, if you would head up there to get away from the Chute aux Bouleaux. At the foot of the island is a big eddy, of Isle Villemomble, there is a heavy eddy; when we get there the eddy catches the bow and there is a current out here, and with the current about that shape, you put the wheel hard-a-port, you run onto here, leave your wheel hard-a-port, it is what we call beam current directly across there to push her out; also there is a heavy current running through here that way that when we straighten there coming down that way, as we call old mills in here, she comes over bodily into the current. If that current there was interfered with, I know it is impossible to take down through the rapids; you can't strengthen the current, because it comes straight across. If you go to convert that any way so as to come on her quarter, I know well enough that she will go through there. To prove that, I was going down with a Standard Oil boat, barge 81, towing with a tug, with a good towing machine on. The tug was pretty well out to Chute aux Bouleaux right straight across going down broad side. This boat here was hard-a-port and had a chock line on so as to keep the line up tight, and when we was in there she pulled around and came alongside of there, and she was ten days there, so I am pretty well familiar with waters down there. So that even if the water wasn't interfered with, the height of the water, the change of the current would make it impossible for the boats to navigate there, and I doubt very much whether when we get down here, when this flood of water comes through here, or inside of the dam, I doubt whether we can make our turn anyway. It is a short turn.

Commissioner Coste: Supposing the eddy was done away with, wouldn't that be an improvement to navigation?

Captain Batten: How would you do away with that? If it was as strong as it is to-day, you remember the wheel is hard over from here to here; until this current gets here I haven't slacked my wheel until the other current is going to get it. It is a steam steering gear.

Commissioner Coste: Supposing you build works in this way?

Captain Batten: I think that would increase the eddy.

Commissioner Coste: The idea is that you require the existing current north of Isle du Moulin.

Captain Batten: Yes, sir. The current is going to increase the strength of the current around here, therefore it would be still stronger up here.

Commissioner Coste: The current through here catches your stern?

Captain Batten: Yes, sir.

Commissioner Coste: And you want the current on your bow to counteract that?

Captain Batten: Yes, sir. You still run on that way with a hard-a-port wheel until that current catches, until you pull over. We depend on that for steering.

Commissioner Coste: That current comes straight down the river that way.

Captain Batten: It wouldn't do any good at all because it is straight across; it has more power going out here than there.

Commissioner Coste: The water comes through the north channel—this is the main land.

Captain Batten: Yes, sir.

Commissioner Coste: This is a very shallow pool?

Captain Batten: Yes, sir; comes down over there a regular hill, and also a strong current there.

Mr. Wright: If this current was going down straight and you came down as you say with your vessel across the current.?

Captain Batten: We turn up head stream.

Commissioner Coste: This current would strike you; you come in here. Supposing we did away with that eddy.

Mr. Henderson: You would only change the location of the eddy.

Commissioner Coste: No, because the current would be confined there. This work, this new work which the people propose is doing away with the current coming from the north, so that the current would come from west to east and then meet the current that also is going there. There would be no eddy there.

Captain Batten: There wouldn't be a great deal. That would strengthen the current here to drive us off the island. You could get hold almost down there; you have got to get in as close as you could get. If you put more current there it would go out here and the boat would be lost. I have seen the rock there a thousand times myself. It is a regular hill.

Commissioner Coste: Supposing we do not put any more water over the Chute aux Bouleaux and take water away from this channel there, it takes it away from this channel.

Captain Batten: If you don't change the condition of things there.

Commissioner Coste: We change the condition of things there, but not here, so that you navigate this channel in the way that you do at the present time; then you have to pass that eddy here before this current from the north strikes you, to put your boat in the right direction; suppose we did away with that eddy and still had a current going this way. You understand what I mean?

Captain Batten: How far would you propose building down here?

Commissioner Coste: Build it to this point.

CAPTAIN BATTEN: How far would that be?

COMMISSIONER COSTE: About 800 feet. It is 400 feet to the inch; about 800 feet, so as to bring it to a point where the two currents, the current to the north channel and the current to the south channel, would meet.

CAPTAIN BATTEN: I do not think you can do that, because this current comes off here. You remember this place is pretty narrow; there is no water here. If we ever get out to that fall, that ends it.

MR. HENDERSON: How is the water south of the channel here?

CAPTAIN BATTEN: There is no water. This is all rough water.

COMMISSIONER COSTE: If they extend this island out here and you come down broad side, that will put your stern on that shore.

CAPTAIN BATTEN: I feel confident that couldn't be done. There is bound to be an eddy, no matter what you do, there is bound to be an eddy.

MR. HENDERSON: Is it the eddy that bothers you, or coming down stream?

CAPTAIN BATTEN: It is both, the current and the eddy.

MR. HENDERSON: It throws you up into the eddy?

CAPTAIN BATTEN: There is a direct current here, and you can't stop a boat in it.

COMMISSIONER COSTE: That wouldn't keep you from throwing the stern on.

CAPTAIN BATTEN: It would strengthen the current; any water that is diverted around here is going to assist our stern to turn around.

COMMISSIONER COSTE: Suppose we ask the company to build a dam following this river 1,000 feet long; what effect would that have on the channel?

CAPTAIN BATTEN: I don't know.

MR. WRIGHT: It would strip your wheel. That is easily understood.

CAPTAIN BATTEN: I don't think it is possible to do it.

COMMISSIONER COSTE: Your wheel will never touch these things. Your boat will remain in the middle of the channel and be carried by the current.

CAPTAIN BATTEN: Oh, no sir. This boat is a twin screw boat.

MR. WRIGHT: It is well understood by any one navigating, Mr. Chairman, that a vessel going down stream with the current, that the current has more effect and will carry the stern faster than the bow; that is well understood, and it is so well understood that the principle is incorporated in the pilot rules on the Great Lakes giving the vessels going down the stream the right of way over the vessel going up, because you can't handle it. If you stop any vessel in the current she will carry up stream. If you put anything along that side, the stern of the vessel will be carried by that current up against it. A sidewheel boat will break her paddle wheels. A twin screw boat will strip her propellors and throw her wheel up there. By building this up here you would shorten this. This allows the stern to come down and the boat's bow come up here. The captain turns to come toward this point, he is carried way down here and still the current is carrying his stern down, and if you don't give him this current, to straighten up to enable his rudder to come around, his boat has got to go around. In two or three different cases I had to stop our starboard wheel and back her up to get her out. If you reduce that current at all, it is impossible for us to run down there with the steamer *Rapids King*.

CHAIRMAN ERNST: You say the flow of the body of the river is this side?

CAPTAIN BATTEN: Yes.

CHAIRMAN ERNST: The main flow?

CAPTAIN BATTEN: Yes, that is the body.

CHAIRMAN ERNST: Some one said a little while ago that the main body was there.

CAPTAIN BATTEN: I think the majority goes down there, but this is the steamboat channel, but I think there is more water going that side.

CHAIRMAN ERNST: What I infer from that, that this water crosses the river.

CAPTAIN BATTEN: Many a time I have rowed from here to there. (Indicating a map from Isle à l'Ail to Isle aux Vaches). This is all dead water. In order to change that current it is bound to go further out; I don't think there is any doubt about that.

CHAIRMAN ERNST: Suppose you shut this off.

CAPTAIN BATTEN: Yes.

CHAIRMAN ERNST: That comes down here. What is there to throw it over there?

CAPTAIN BATTEN: There will be that water coming down here.

CHAIRMAN ERNST: Because this goes through here.

CAPTAIN BATTEN: Yes.

CHAIRMAN ERNST: And instead of going over there, why shouldn't it go over there?

CAPTAIN BATTEN: It can't go down there. The water runs right to there and then switches off. I have been around there. I can row from that island to there.

COMMISSIONER COSTE: Oh, there is no water coming from this channel this way.

CAPTAIN BATTEN: When it gets down here?

COMMISSIONER COSTE: I am speaking of the new conditions of affairs when this is shut off, there is no water going through there?

CAPTAIN BATTEN: No, sir.

COMMISSIONER COSTE: Why isn't this volume discharged down this side of that Isle aux Vaches very much increased?

CAPTAIN BATTEN: It might be a little, but I don't think so. I think the bulk of it will go off that way.

COMMISSIONER STEWART: The level is reduced here; it will have to draw something that way in spite of it.

CHAIRMAN ERNST: This impulse that it has in this direction across the river is taken away.

Captain Batten: That comes out here and is in the same level as this here pretty much until it gets here; there is hardly any water there now; I have seen the rafts aground. [illegible]

Commissioner Stewart: If half of the water of the river goes down there and that is so very shallow it can't get through, a great deal must go that way.

Captain Batten: Yes, sir.

Mr. Wright: That will increase the amount of current, catching your vessel's stern and throw it up stream.

Mr. Henderson: The chairman stated when this dam went across here there was no water here. Won't there be a tremendous amount of water coming through here? I understand there is practically about a third of the total water is going to be used by this water-power; now, that must necessarily decrease the volume going down the other side.

Commissioner Stewart: No, they won't take all the water, won't go through the canal; it will go down here.

Mr Smith: Do you know where it will go? Can you tell me where it will go?

Commissioner Stewart: No. Except it goes through—

Captain Batten: It runs across this way, up around here. I have often rowed from there to there every day, I rowed across there to go to the Cedars and go to the island. Of course there is current but not enough to speak of. There is a big eddy there now, and I think it will be still greater.

Mr. Henderson:—You talk about as to whether this current will run straight down after this is built. I have been connected with the Montreal Transportation Company 25 years, and we know the so-called improvements made at the canal entrances on the St. Lawrence river, and the engineers said it would improve it, and in most cases the entrances are worse to-day than they were twenty years ago, showing that no engineer can tell. He may experiment and he can plan, but he can't say what effect the running of a bar out into the current is going to have on that current; it very often goes just the very contrary to what the engineer expected; practical experience has shown that. Therefore we claim that no engineer to-day can tell what effect that dam is going to have there, and until he can demonstrate to us and show us that we are going to have a good navigable channel, that should not be built.

Mr. Wright: Past experience has proved it.

Captain Batten: I feel confident that the change of current, any conditions changed there, it is impossible to go down. I have been running there nearly every day, I average four or five days a week in the summer, I have been 35 years connected with it. There was Lachine rapids, the engineer said—we grew up with the first part of the dam that was built, and then it was very difficult to get down, had trouble with ice in winter, and they increased the length of the dam. I made two or three trips. And even to-day I consider the danger is 25 per cent more on Lachine rapids than previous to the dam. Previous to the dam the water at the gate always ran south and we were prepared for that. Understand, Mr. Chairman, she was prepared for the boat to take a sheer. Now when you come it has formed an eddy, the current runs one way and there is nothing to tell us when that eddy is changed; we all come there prepared, watching the boat every time, you don't know whether she will run north or south. Our boats are deep on the bottom for that, so I think the same thing will occur right here.

Mr. King: If there are no specific questions to be addressed to Captain Batten, I would ask that Mr. A. A. Wright, president of the association last year should now speak for the heavy interest and would cover various points that have not been specifically put in our memorial. Mr. Henderson's interests are practically identical.

Mr. Wright: Mr. Chairman and gentlemen, on behalf of the bulk of the heavy freighters I would go a little further in my objections, or rather in our objection to this scheme than have been touched on yet. We take the ground that the freight navigation in the St. Lawrence is an inalienable right of the citizens of Canada and the United States. The waterways to the sea are free to the citizens of both countries. I am not sure, but I think the United States have treaty rights on the St. Lawrence the same as we have. Now, the whole country tributary to the Great Lakes from the head of Lake Superior west, and west of Lake Michigan, as well as western Canada, is all depending on the rates made by our vessels from the head of Lake Superior to Montreal for their freight rates to the seaboard. The rates to-day are made by the vessels navigating the St. Lawrence canals. Now, to follow out what this may mean, starting to dam the St. Lawrence, we claim that no government which happens to be in power, either in the United States or in Canada, for a short space of time, the term of years they are elected for, have the right—they may have the power, but they haven't the right, to take something which belongs to all the citizens, and give it to some one or a number of citizens for their personal profit. That is the first ground we take. Again we take the ground that the whole onus of proof that navigation will not be interfered with rests entirely on the promoters of any of these schemes. The opinions as to the effect of dams on currents given by engineers are not evidence, because they are incompetent to show as to what the effect of these dams will be on currents. Men who earn their living piloting boats in currents are the only men, we claim, who are authorities on the effect of currents on navigation. Now, all the pilots on that river are unanimous in believing that any interference with the present locations on the river, the present channels, will make it practically impossible for any company to run passenger steamers on that river. Now, it would not be enough in our opinion, even if these power companies were to buy out the rights of every individual who is operating on that river, because you or any other man has the right or power to put a line of vessels on that river and can claim free navigation of that. Under the Rivers and Streams Bill, which was an original dispute as to what was a floatable river, one individual built a dam on a small stream to improve his facilities in floating logs. Another operator who owned timber above that came along and wanted to drive through that improvement and pay for their use. He admitted that it was an improvement. The builder of the dam refused, and it was fought through the courts, and the Ontario Government passed this Rivers and Streams Bill and it was then fought through to the Privy Council, and it was held there that no one had the right to interfere with any other man's right to use a navigable stream. So that we claim that the Calvin Company, the Richelieu and Ontario Navigation Company, or any other navigation company now existing or that may hereafter exist, have an inalienable right to the free use of that river as it is. Now, on the other hand as it affects individuals and the men now operating on the river, take it as it will affect the freighters, in 1889 there were ten canal sized boats and smaller owned in Canada, operating and carrying grain from Fort William. To-day there are about seventy-five, and that is in ten years. Ten years ago there were probably one or two boats trading through from Fort William to Montreal. To day there are 25 Canadian boats, and there are several United States vessels; one line, the Great Lakes and St. Lawrence, I believe, have ten vessels that have operated through to Montreal, besides a large number of vessels carrying coal from Lake Erie ports down to Quebec, and carrying pulp wood back for United States paper mills. It is a natural inference that that growth will continue; all you have to do is to look at the growth of the United States trade through the Soo Canal in the last 25 years, the development of the Canadian Government, the opening up of iron ore mines and the development of the Canadian West is only now beginning, and this annual growth which has been maintained steadily for the last ten years is bound to continue. Now, what will be the result? If you interfere with the free running of the St. Lawrence by rafts or any other boats that can now run, you have got to divert them into the canals. That will create a congestion even at the present time. What will it be in 25 years, to say nothing of what it will be in 50 years? I think I am perfectly safe in saying that the present canal system on the St. Lawrence in less than 50 years will probably have to be diverted. Now, then if these rights are granted to power development companies—supposing you grant them on one rapid, you have no good reason for not granting them on another, until you have every rapid on the St. Lawrence blocked up with power companies. Then you will put the traffic on the St. Lawrence out of business; you will put the rafts or anything else and the increased tonnage into one lot, and then when you come to duplicate them you will be getting this situation which exists to-day at the Soo where the United States Government granted rights to power companies which have held up the construction of a third canal I believe now for three years, and I do not know yet just what arrangements the United States Government are being able to make; I understand the War Department has condemned the power, but it may cost the United States people a large sum of money to get back the right which they gave away. Now why should we take the risk of giving away rights which may have to be purchased back in future years, and hamper the commerce of the countries which every citizen of both countries has estate in, for the benefit of private corporations?. Now, it may be claimed that it is a good thing to develop water-powers. Granted. But there are places where it should be granted, and where it should not. Now, if, after all other water-powers have been developed and it is found for the requirements of commerce that it is necessary to develop these water-powers on the St. Lawrence, it should only be granted and controlled by the governments of the two countries for the benefit of all the people, and not for the benefit of a few individuals.

Now, I have said that the onus of showing to this commission without any question of doubt that navigation interests or the interests of the public will not be interfered with rests entirely on the promoters of all of these schemes. We have I think shown in the only way it can be shown, by the opinions and the experience of the men who make their living by navigation. We have no grudge against power development companies, only so far as it is going to interfere with the means of our livelihood. And I claim that so far they have not shown, and it is practically impossible for them to show it, because as proved by the present St. Lawrence canals, as well as by the Soo canals, engineers cannot estimate the effect of a current. Take the Soo Canal, the Canadian Soo canal, it was supposed when that canal was designed that they had discovered a method that they could put water into that lock quickly without disturbing a vessel. Now, even with that method they broke chock, tore right in two a big rub chock, which shows that they haven't been able to estimate current. Take the St. Lawrence canals, to say they have proved conclusively, and vessel owners are paying for it, that the franchise granted to the power companies along that canal is costing the Canadian vessels alone, the freight vessels, practically seven cents per ton on all the freight they are carrying through those canals, in extra insurance over and above the insurance rates on vessels using the Welland canal where the power is not developed to the same extent. We were always assured by every one of the promoters and all the engineers that those power developments would not in any way interfere with navigation, and they agreed they would see that they did not, and this is the result, that it costs vessels seven cents a ton on their vessels from Prescott to Montreal. There is one per cent per annum on the full value of your vessel navigating from Prescott to Montreal, and that has only been put on within the last year or two as a result of the experience of underwriters repairing damages sustained by boats in those currents. The point is this: You are developing power on one side of the canal; the boat comes along here, the captain comes along, he believing there is a swift current here and he allowed for that, or didn't allow for it, and got into trouble, and the next time he comes along they aren't using all the power and there is no current making as may be shut down, and he allowed for it and gets caught. So that where power is being developed it is absolutely impossible for any navigator to tell current is going to meet. When he is dealing with the natural conditions he knows if it blows from the north, west, south or east, it will come a certain way at a certain point. When they are using power he cannot tell, because he doesn't know how much power they use, and he is coming along night and different times and he cannot tell what that current is going to be when he comes to it, so that that shows conclusively to my mind, and I trust to the minds of this commission, that whenever you interfere with natural conditions you are putting up conditions that no navigator can foresee, and past experience has proved it, because vessels using it are paying for it and they will pay more, because there have been heavy damages incurred during the past year, and the underwriters are not in business for their health. Whenever they are paying heavy losses on any particular location, they simply increase the rates there.

COMMISSIONER STEWART: Did the Marine Association protest against that power development in the Soulanges canal, the one that is just completed now?

MR. WRIGHT: I do not think we had any opportunity. We have protested against every power development that we had notice of.

COMMISSIONER STEWART: It is very funny, in going up and down there that you did not know this was going on.

MR. CALVIN: The power was given before we knew anything about it.

MR. SMITH: I might call your attention to the fact that a power scheme I understand has been granted to the syndicate called the Robert Syndicate. They are given the right to the Beauharnois canal; they are given the canal to develop 8,000 horse-power with the right to take 80,000 more horse-power out of this stream

MR. WRIGHT: Mr. Chairman, we have, since I have been connected with the Marine Association, asked our government to always allow us to be heard before any of these franchises are granted. We have occasionally had notice, but more often we have found that the franchises have been granted, or that they have been granted years ago under some franchise that has not been operated and they are simply granted the permission to go ahead, and when we do get notice from the government, it was usually so short we couldn't get people together and when we did as a rule they said we didn't know what we were talking about, the engineer said this and that, and that settled it; we weren't supposed to know anything about our own business. They assumed in every instance that engineers could say more about what the effect of currents and conditions would be than men who earn their living that way.

I think I have covered most of our objections, and I do not wish to take up the time of the commission any more. If they have any questions to ask, I will be very glad to answer any questions; and I may say further that we appreciate the changed condition which this commission has made in dealing with this matter over what our own governments have done, because in every case here we have had, as I understand from the secretary, notice of when hearings would come on in this matter, and I wish to thank the commission for their courtesy in that matter and I hope that our statement of the case will have their consideration.

COMMISSIONER COSTE: Mr. Wright, do you deny to the government the right to improve the St. Lawrence river?

Mr. Wright: No, sir. We desire the government to improve the St. Lawrence river; but the whole question is, what constitutes an improvement? We claim that this is not an improvement, but that it is an absolute injury to the St. Lawrence river and to the rights and interests of the citizens of Canada and the United States. That is our position.

Commissioner Coste: Who is to be the judge of that?

Mr. Wright: As far as it affects navigation, I claim that the only men who are competent to say are the men who are earning their living by navigation, not engineers who have had no experience and could not take a vessel down that river if they were given the vessel—and if I owned a vessel on the river I would be willing to give it to any of them if they would insure her, to let them prove their knowledge of the effect of currents.

Commissioner Coste: Under the improved conditions?

Mr. Wright: Under the improved conditions.

Commissioner Coste: Who is to be judge as to whether a piece of work by the government is an improvement or not?

Mr. Wright: The only thing we can judge by is past experience, and our experience in the past without exception has been that the engineers have always been mistaken in their predictions of the effect of changes in the current.

Commissioner Coste: In other words, the best thing is that the government had better not touch the river.

Mr. Wright: It is nothing of the kind. Supposing there was some place where there was a rock in this channel, if they could take it out, that would be an improvement to the river. But when you attempt to put in dams and grant franchises which probably are given away for nothing and which would have to be bought back, you would be met with what we are always met with when vessels' rights are demanded, that the innocent investors had put their money up and we cannot interfere with that, we have got to pay them back. Why should they take something which is the property of every citizen of the United States and Canada and give to a private corporation and take the risk of jeopardizing or injuring the interests of all the people, and then have to buy it back?

Mr. Henderson: I would like to say a word or two on Commissioner Coste's question to Mr. Wright a few minutes ago, as to whether the government should improve the St. Lawrence river?

As representing probably the company owning the largest tonnage operating on the St. Lawrence river, I would like to say this, that we are heartily in sympathy with the government making alterations or improvements to the river channels, and we heartily thank the government for the work that they have done in the past. At the same time we have always contended that the government in starting these improvements, in making their plans for these improvements, that the government would do well if they would have their engineers consult with the river pilots, the men who are piloting the boats and who are thoroughly conversant, who have been brought up from deck hands until they became masters of their vessels, because these men have always started in as deck hands or wheelsmen on their boats and gradually worked up and spent their lives on the St. Lawrencw river, and we have always claimed that the engineers would do well to consult these men when they were making their plans. Unfortunately they have not always done that, and the result has been largely due to not consulting pilots, that mistakes have been made. I think the Department of Public Works and the Department of Railways and Canals will admit that engineering mistakes have been made on the St. Lawrence. We give the government credit for rectifying the mistakes. If might mention one case in point, one of a number. The improvement between the head of Kerchen Canal and Prescott some two years ago they endeavoured to improve that channel; they built the north channel. Mr. Stewart and Mr. Coste probably know about the north channel. After the north channel was built our pilots after first experience or two were afraid almost to navigate that channel; it was a very difficult channel; in fact, to-day, instead of taking from four to six barges down in tow between Prescott and the head of the canal, we do not attempt to take over three barges down through the north channel. And our pilots at that time said the government engineers were making a mistake; their channel looks nice on paper, it is a perfectly straight channel almost as to crow flies, it is very nice; it is an expensive work; they are certainly not trying to save money; but they created a cross current which made it very difficult to enter that. They improved that channel afterwards by running out a long pier on the west end of it; they certainly improved it over what it was at first. But what are they doing to-day. They have decided that the north channel even with the improvements is not a good channel and they have barges at work—did have last summer, and will have barges at work I suppose next summer digging a channel along and around the north side in exactly the spot where our pilots said the original channel should have been built.

Chairman Ernst: I believe that completes the list of the names that have been given to me. Do the members of the company care to say anything further?

Mr. Calvin: I was going to suggest that so far as we are concerned we would be relieved if this dam (indicating on map dam connecting Isle aux Vaches with mainland) was not built. That would I suppose lessen the head of water, but would give them an immense water-power. I do not pretend to say whether they have a right or haven't a right to the water. I am thinking now about the navigation of our rafts. That would not be interfered with if that was left as it is, if this dam from Isle aux Vaches to Pointe des Cèdres was not built, if we didn't have any obstruction there between these two points, between Pointe des Cèdres and Isle aux Vaches. We are under contract now for this season, this approaching opening of navigation we are under contract to navigate that. Where are we going to if that is blocked? We have undertaken to continue this work for the year 1909 the same as we did in 1908, and previous years, and all we ask for is fair play.

Mr. Smith: Mr. Calvin having stated that possibly by not making that dam there, that he could get along. I feel that you should hear from Captain Batten as to how it would affect the Richelieu Company from a practical standpoint.

Captain Batten: It is hard to say. There is one thing. I would like to ask; What protection have we when coming through Bacot Hayes down here? This is the mainland. This is all shallow water both sides below this. This is north-east of it. The main land runs here. Our channel goes down there and we take a short cut. We put our wheel hard-a-port. That water comes from there, south.

Commissioner Coste: You come around here and you shoot that way.

Captain Batten: That is Bacot Hayes. There is our channel through here. There is a cut there. Now, if this current is coming down here, this is all shallow on both sides. That is the only cut the whole river across that you can get through from one shore to the other, just one little cut there, and the mainland here. We are only about 200 feet from the main shore.

Commissioner Coste: You take the north channel?

Captain Batten: Yes. There is not enough water there for us.

Commissioner Coste: There is 19 feet, 16 feet, 14 feet.

CAPTAIN BATTEN: I will guarantee that there isn't five feet and a half in the south channel. I have sounded that fifty times, that is, the old channel. As we used to say, it would go over the hill. You come right down through, you come on the main line there, the effect is going to be here, all down here is all shoals. That is going to be a serious matter to get out there. It is all we can do to get out now.

MR. SMITH: What would you do, supposing you were coming down here when this was running?

CAPTAIN BATTEN: We don't know what we would do.

MR. SMITH: You don't know what effect that would have?

CAPTAIN BATTEN: No, sir.

MR. SMITH: Supposing you came down to-day and that was running and you found it put you ashore, and the next time you came down it wasn't running, the next day.

CAPTAIN BATTEN: You don't know what would be the effect?

MR. SMITH: You can never tell when you are coming by it how the current is going to affect you because you wouldn't know whether the power was being used or not. You don't know.

COMMISSIONER STEWART: What are you going to do with this power?

MR. HOLGATE: That is a long way off.

MR. SMITH: We are trying to protect ourselves for the future.

CHAIRMAN ERNST: Is that the new power?

CAPTAIN BATTEN: That comes over here; this is shallow water over here. That is going to be a serious thing there if they build it way out there.

COMMISSIONER COSTE: This channel in the south by the Bacot Hayes—

CAPTAIN BATTEN: I have sounded that dozens of times.

COMMISSIONER COSTE: You have sounded it on the shore?

CAPTAIN BATTEN: Tried it all around there.

COMMISSIONER COSTE: You cannot go against those soundings. It is marked 19, 16.

CAPTAIN BATTEN: You can't get over the thing. I have been over the whole thing. There is hardly a place there.

COMMISSIONER STEWART: There are only a few casual soundings. I do not think they properly represent it.

CAPTAIN BATTEN: He said he had rather take those soundings than mine. I have sounded the whole place dozens of times. I spent two weeks in the spring of the year sounding. They sent me to do sounding. That is the way I came to sound it all over.

CHAIRMAN ERNST: What is the depth in there (indicating)?

CAPTAIN BATTEN: You know there is an old mill there. There is no water around here.

CHAIRMAN ERNST: Between the shore and the island there, any depth in there?

CAPTAIN BATTEN: That is at the Cedars. That is way at the head, that is deep water. That is where the dam is going to be.

CHAIRMAN ERNST: No. Across here?

CAPTAIN BATTEN: Oh, here, this island? No, there is no water. Very shallow there. There is no water at all there. I have seen rafts stuck on there and have to unload them.

CHAIRMAN ERNST: Mr. Holgate, do you care to make any further remarks?

MR. HOLGATE: Only this, Mr. Chairman, that from all that has been said this morning, and I have listened to everything, I have heard no argument advanced against the principle of developing the power at Cedars rapids. The principle has been endorsed of developing power by the various speakers, and that the supervision of the river is admitted to be in your commission. Now, we simply let the matter rest where it is, as far as we are concerned; we have no further arguments to advance. It was at my personal request that Captain Batten was brought here so that he could give the information that he has given you this morning. We want information. We want the information to be laid before your commission so that the proper safeguards to navigation may be provided for. Speaking personally, there is no stronger advocate for the continuance of navigating the St. Lawrence than I am, and I want it understood that way, that I cannot be a party to anything that would be a prejudice to the navigation of the St. Lawrence river, and we leave ourselves entirely in the hands of the commission, believing that the public want that development and that in making that development the navigation of the river must be maintained in its integrity. The legal rights of the company are complete. The matter is not an airy scheme; it is a genuine business proposition and we are anxious to get the matter decided so that construction may be commenced at an early date. Whatever safeguards in a definite way that the commission wishes to stipulate, or in a general manner, so as to provide for future contingencies, the company is ready to subscribe to.

MR. KING: Mr. Chairman, Mr. Holgate has been very fair in his statement as to his desire to see navigation interests protected in their integrity. As to the statement that no objections had been made to the development of power on the St. Lawrence, I do not think any of us propose to impugn the understanding of the commission by attempting to rehearse what has been said. I want the record to speak for itself, and I am sure it will to our satisfaction.

MR. DESSAULLES: On behalf of the Cedars Manufacturing Company I have very little to add to what Mr. Holgate just said. The charter giving us the right to use the water at this special point has been granted by Parliament. There has been a good deal of argument that has been given here which would rather affect the constitutional right of Parliament to grant such franchises., rather than the matter which is now before the commission. The franchises have been granted, the matter was referred to the Public Works Department for approval of the plans, and after proper advertisements in the papers, etc., the Public Works Department has now referred the matter to this commission, I understand to provide the proper safeguards for navigation, which we always understood that we had to provide. I believe that all the difficulties that have been anticipated or is said are anticipated can be covered by a contract and can be provided for by engineers. It is an enginering problem, and proper government supervision or proper supervision of this commission can safeguard all interest that might be affected by the scheme of development.

CHAIRMAN ERNST: The commission are very much obliged to you gentlemen for coming here. If there is nothing further to be said, the public meeting will be closed now.

Hearing closed.

1910

REPORT OF THE INTERNATIONAL WATERWAYS COMMISSION

ON THE REGULATION OF LAKE ERIE WITH A DISCUSSION OF THE REGULATION OF THE GREAT LAKES SYSTEM, TOGETHER WITH APPENDIX, TABLES AND PLATES.

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INTERNATIONAL WATERWAYS COMMISSION.

OFFICE OF AMERICAN SECTION,

BUFFALO, N.Y., January 8, 1910.

1. The Act of the Congress of the United States, approved June 13, 1902, which requested that the Government of Great Britian be invited to join in the formation of this Commission, defined one of the duties of the Commission as follows, viz.:

'The said Commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable, shall make recommendations to their respective Governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof.'

2. The Great Lakes, lying between the United States and Canada, with their connecting channels and their natural outlet to the sea, the St. Lawrence River, of which a description will be found in the appendix to this report, constitute the most important system of inland navigation in the world. The traffic which passed through the Detroit River, its busiest link, in 1907, amounted to 71,226,895 tons, valued at about $700,000,000. About 70 per cent of this traffic is carried in large freight carriers which are loaded down to the greatest draft that can be carried into the harbours or through the channels between the lakes. With the depth now available they are usually loaded to a draft of about 19 feet, but careful watch is kept upon the stage of the waterways and advantage is taken of any temporary increase of stage to load the vessels deeper. The number of deep draft vessels, as well as their size, and the share of lake traffic which they carry is increasing each year, while the lake traffic itself is increasing with great rapidity. Vessels which would carry an additional load of 85 tons for each inch of additional draft have recently been added to the fleet. Every inch added to the available depth of water would therefore, be of material benefit to commerce.

3. The method heretofore employed for deepening the natural channels is that of excavation, but it has been suggested that a more economical and otherwise better method would be to raise the surface of the water by obstructing the flow of the outlets. For Lake Erie in particular a definite plan, with estimates of cost, was proposed by the Board of Engineers on Deep Waterways in their report dated June 30, 1900, published as House Document No. 149, Fifty-sixth Congress, first session. The official character of this report and the ability displayed in its preparation seem to have led to the provisions of law under which this Commission is now acting, and to make of it a proper starting point for this discussion. It was proposed by the Board to "regulate" the level of Lake Erie.

4. By the term "regulation of lake's level" is meant the maintenance of its level at or near some fixed stage, which implies such control of the discharge as will make the latter nearly equal to the total supply—rainfall and inflow less evaporation—at all times. In some cases, this may be accomplished by a submerged weir in the outlet, of such length that a small increase or decrease of stage will increase or decrease the discharge over the weir by an amount equal to the change in the total supply. A work of this kind operates automatically, but manifestly it requires more or less range of stage and the topography must be such that a great length of weir can be found ; it does not lend itself to the most complete regulation.

5. The works proposed by the Board were for the regulations of Lake Erie within a range so small that it might be considered almost a complete regulation. They consisted of a submerged weir in connection with a set of sluice gates "so

designed that with the sluice gates all closed the low-water flow of the regulated stage of the lake will be discharged over the fixed submerged weir, and with the sluice gates all open the additional volume of overflow necessary to maintain the lake at nearly the same level will pass through the sluices at times when the lake is receiving its maximum supply." They were to be placed near the angle in the Bird Island Pier, at the head of Niagara River, and were designed to hold the level of the lake at or near 574·5, old levels, or 574·7, 1903 levels, above mean tide at New York. This is higher than any monthly mean stage reached since the authentic records have been kept, that is, since 1860. It was a maximum not to be exceeded. It is not definitely stated what the minimum monthly stage would be under regulation, but it may be inferred from certain paragraphs in the Board's report that it was to be about 573·7, 1903 levels. (See paragraph 104 of the appendix.)

6. The Great Lakes constitute a series of enormous natural reservoirs, each of which serves to regulate the flow in the river constituting its outlet, and to maintain the lake below. They are inter-dependent. The study of one, to be complete, must include the study of all. The total area drained by them is about 287,688 square miles, an area considerably larger than the German Empire. Of this total, about one third is occupied by the lakes themselves, that is, is devoted to reservoir purposes. The result is a uniformity of flow which is truly wonderful. In table A are given the areas of the lake surfaces and of the drainage basins.

TABLE A.

Lake.	Area of Lake Surface in Square Miles.	Draining Area Including Lake Surface in Square Miles.	Ratio of Lake to Drainage Area.
Superior	32,060	76,134	1·2.237
Michigan	22,336	65,799	1·2.95
Huron	22,978	72,008	1·3.13
St. Clair	503	6,194	1·12.31
Erie	9,968	34,573	1·3.47
Ontario	7,243	32,980	1·4.55
Total	95,088	297,688	1·3.02

Authority: 1906 U. S. Lake Survey report.
The areas of the small lakes and streams are taken as a part of the inland area.

In Table B are given the average and the extreme variations in the levels during the period from 1860 to 1907.

TABLE B.

	Superior.	Huron.	Erie.	Ontario.
	Feet	Feet	Feet	Feet
Extreme range 1860-1907	3·32	4·64	3·89	5·54
Maximum range in 1 year	(1869) 2·67	(1876) 2·94	(1892) 2·28	(1867) 3·65
Minimum range in 1 year	(1891) 0·49	(1879) 0·59	(1895) 0·87	(1907) 0·79
Average annual range	1·18	1·21	1·56	1·93

In Table C are given the average and the extreme variations in the discharge of the outlets for the period 1860 to 1907.

TABLE C.

	St. Marys River.	Detroit River.	Niagara River.	St. Lawrence River at its Head.
	c.f.s.	c.f.s.	c.f.s.	c.f.s.
Average discharge for entire period..	82,000	204,200	212,200	254,400
Greatest excess average for any one month..............................	46,700 Sept., 1869 57%	71,200 July, 1833 35%	45,600 June, 1876 21%	96,800 May, 1862 38%
Greatest excess average for any one year..............................	19,100 1876 23%	30,200 1885 15%	26,500 1876 12%	49,000 1862 19%
Greatest deficiency average for any one month..............................	33,800 Feb., 1893 41%	98,900 Feb., 1874 48%	43,500 Mar., 1896 20%	102,200 Feb., 1902 40%
Greatest deficiency average for any one year..............................	16,900 1879 21%	30,600 1896 15%	31,800 1895 15%	62,800 1895 25%

No work of man ever has approached or ever will approach this perfection of regulation. The question now is, can he add to that which exists in the important degree.

7. Evidently the answer to this question must be based upon careful analysis and close computation. The data for its solution are found in the records of the water levels, and in the measurements of discharge taken during the last 48 years, principally under the direction of the Chief of Engineers, U.S. Army. Actual values assigned to rainfall and evaporation are not well determined and cannot be used. It is the relative value of these elements which it is necessary to know, and that value is found in the discharge measurements.

8. Soon after the organization of the Commission, a committee of two of its engineer members was appointed to collect all of the available data, and to make an hydraulic analysis of the general regulation of all the lakes. It was well known at the outset that this would be a long and laborious task, but it proved to be more so than was expected, and it was only recently completed. The full report of the committee is hereto attached as an appendix. A brief synopsis of it is here given.

9. Beginning about 1860, and continuing to date, daily or tri-daily water-level observations have been taken at Marquette on Lake Superior, Milwaukee on Lake Michigan, Cleveland on Lake Erie, and Oswego and Charlotte on Lake Ontario. Beginning at later dates, observations have been taken at Sault Ste. Marie, Harbor Beach on Lake Huron, St. Clair River, St. Clair Flats Canal, Windmill Point on Lake St. Clair, Amhertsburg on Detroit River, Buffalo on Lake Erie, Ogdensburg on St. Lawrence River, and Lock 27 at the head of Galop Rapids, Lock 24 at the head of Rapide Plat, and Lock 21 at the head of Long Sault Rapids, on St. Lawrence River. Self registering automatic gauges giving a continuous graphical record of the rise and fall of the water, were not installed until 1899. The record for each of the above-mentioned gauges, except the last two, from 1860 to 1907, inclusive, has been completed by interpolation. For Lock 24, on the St. Lawrence, the record has been completed from 1880, and for Lock 21, from 1870. There are a few isolated records of dates earlier than 1860, but they are not well authenticated and cannot be used here.

10. As was stated in our report of January 4, 1907, upon the Chicago Drainage Canal, "Variations in the level of the lake's surface, due to winds and to change of barometric pressure, are frequent and irregular and at times violent. Variations of more than 6 inches are very common, often occurring hourly for many hours in succession, while variations of 2 or 3 feet within an hour are not uncommon. Besides these irregular variations there is a regular annual variation due to difference in rainfall, evaporation, and run-off, the water level being highest in midsummer and lowest in midwinter. The levels are affected also by the greater or less severity of the winter and by the consequent greater or less decrease in the discharging capacity of the outlets by ice. In order to study the annual oscillations it is necessary to eliminate the irregular oscillations, and that is accomplished by using the average levels for a month." The monthly mean stage has been obtained by taking the average of the gauge readings for a month, and is given for each of the above-mentioned gauges in Tables 2-17. The monthly mean stages of Lakes Superior, Michigan-Huron, St. Clair, Erie, and Ontario, from 1860 to 1907, inclusive, are shown on Plate 1.

11. The volume of discharge of the outlet at any given stage is obtained from a formula deduced from actual measurements of discharge at such stages as happened to exist at the time of observation. Formulæ of this kind were deduced for each of the outlets of the Great Lakes. During the winter of 1896 discharge measurements of the St. Marys River, the outlet of Lake Superior, were made at Spry's Dock Section, located about a mile below the St. Marys Rapids. In 1902 discharge measurements of the same stream were made at the International Bridge which connects Sault Ste. Marie, Mich., with Sault Ste. Marie, Ontario. In 1905 similar measurements were made at "Section Brewery," located about 2,000 feet below Spry's Dock Section. All of these observations were made by the U. S. Lake Survey. Up to the year 1887, the discharging capacity of the St. Marys River remained nearly uniform. Since that date numerous artificial works have been constructed at the Sault, which have modified its discharging capacity to an important degree. During the years 1887 and 1888, the International Bridge was built, which with its piers and approaches materially reduced the cross section. In 1892, the Edison Sault Electric Company placed power works in the bed of the stream. In 1895, a power canal on the Canadian side was opened to use. In 1905, a power canal on the Michigan side was opened to use, compensating works in connection therewith having been placed in the river in 1901 and 1902. The amount of water diverted by the power canals has increased from time to time since they were opened, and so has the quantity used by the American and Canadian locks. To conform to these changes it was necessary to deduce eleven different discharge formulæ for the St. Marys River alone.

12. The discharge formulæ for St. Clair River, the outlet of Lake Michigan-Huron, was deduced from observations made by the U. S. Lake Survey in 1899, 1900, 1901, and 1902. In 1900, the Chicago Drainage Canal began diverting water from Lake Michigan. The amount diverted between January, 1900, and June, 1904, inclusive, was computed from data furnished by the U.S. Engineer Office at Chicago. The flow through the canal since June, 1904, has been assumed to be 4,167 cubic feet per second, the quantity authorized in the permit of the Secretary of War. It is believed to have been greater, but the difference is not sufficient to vitiate the results sought for here. An application by the Commission to the Sanitary District of Chicago for a copy of their record met with a refusal to furnish it.

13. The discharge formulæ for the Detroit River was derived from measurements taken at Fort Wayne, Michigan, by the U. S. Lake Survey in 1901 and 1902.

14. For the Niagara River, the outlet of Lake Erie, discharge measurements were made at the International Bridge at Buffalo, and at a point about

1,800 feet down stream, called the "Open Section." These observations were begun in 1897 for the Board of Engineers on Deep Waterways, and were continued in 1898, 1899, and 1900, by the U. S. Lake Survey.

15. The discharge formulæ for the St. Lawrence River, the outlet of Lake Ontario, was deduced from measurements made by the U. S. Lake Survey in 1901 and 1902 at 'Three Points Section', situated about 15 miles below Ogdensburg, N.Y., and 9 miles below the head of the Galop Rapids.

16. With the discharge formulæ and the gauge records, the average discharge, in cubic feet per second, has been computed for each month from 1860 to 1907, inclusive, for each outlet. The results for St. Marys River are given in Table 19; those for Detroit River in Table 20; those for Niagara River in Table 21; and those for St. Lawrence River at its head in Table 22.

17. The total supply of water to a reservoir or lake depends upon the flow or transmitted supply from another watershed, the precipitation on the surface of the lake, the run-off from the lake's watershed, and evaporation from the lake's surface, or the outflow from and storage in the lake. Of these factors, for the Great Lakes, the transmitted supply, the discharge, and the storage are known separately, while the value of precipitation, run-off, and evaporation is known collectively. The local supply for any lake is the water-yield from its own watershed, and is equal to the total supply minus the transmitted supply or inflow from the watersheds situated above. The supply factors have been deduced for Lakes Superior, Michigan-Huron, Erie, and Ontario, for each month from 1860 to 1907, inclusive, and the results are given in Tables 24, 25, 26, and 27. They are shown graphically upon Plates 2 to 17 inclusive.

18. It is to be noted that minus values for the monthly mean local supply have frequently occurred, that is to say, the evaporation has frequently exceeded the precipitation and run-off. For Lake Superior, minus values occurred at some time during 41 of the 48 years considered; this usually happened in December, but it sometimes occurred in each of the months from October to April, inclusive. The greatest minus value occurred in December 1870, when the evaporation exceeded the precipitation and run-off by 106,600 cubic feet per second.

19. For Lake Michigan-Huron, minus values occurred in 33 out of the 48 years considered. This usually happened in September, October, or November, but it sometimes happened also in August and December. The greatest minus value occurred in September, 1871, when the evaporation exceeded the precipitation and run-off by 125,700 cubic feet per second. In that year minus values occurred in each of the four months from August to November. In 1894, minus values occurred from August to December, inclusive.

20. For Lake Erie, minus values occurred with extraordianry frequency. They are found in every year, and, in many years in all of the last six months. From June, 1884, to March, 1885, inclusive, that is, for 10 consecutive months, evaporation exceeded precipitation and run-off continuously, the average excess for the entire period being 40,400 cubic feet per second. There is no month, except the month of May, in which a minus value has not been found in some year between 1860 and 1907. The excessive evaporation in Lake Erie may be attributed to the facts that the lake is shallow and its longer axis lies in the direction of the prevalent winds.

21. For Lake Ontario, minus values occurred less frequently than with the other lakes, but were found in 27 out of the 48 years. The greatest minus value occurred in January, 1877, when the evaporation exceeded the precipitation and run-off by 40,300 cubic feet per second.

22. To obtain the general law which governs these supply factors, Table 28 was prepared, which gives their average for the entire period from 1860 to 1907. The averages for Lake Superior, Michigan-Huron, Erie, and Ontario, are shown graphically on Plate 18. From these, it appears that evaporation

exceeds the local supply in Lake Superior during December and is nearly equal to it during January; that evaporation is nearly equal to the local supply in Lake Michigan-Huron during October and November; that it exceeds the local supply in Lake Erie during the last half of the year, July to December; and, as a general rule, does not exceed the local supply in Lake Ontario.

23. The maximum stage of one lake does not occur at the same time as that of another lake, and this is true also of the minimum stage. Nor does the maximum outflow occur at the time of the maximum total supply. The lake may continue to fall while the supply of water is increasing and *vice versa*. These great forces require time to act. The following table shows the ratio, R, between the maximum discharge and the maximum total supply for each lake, the time interval, T*max.*, which elapses between the maximum total supply to any lake and the maximum discharge from the lake, and the time interval, T*min.*, which elapses between the minimum total supply and the minimum discharge.

Lake.	R	T Max.	T Min.
Superior	0·524	98 days	91 days
Michigan-Huron	0·647	82 "	101 "
Erie	0·884	76 "	132 "
Ontario	0·955	56 "	20 "

From which it is to be inferred that the interval of time required for an increasing supply to show its effect upon the level of Lake Superior is about 98 days, and for a decreasing supply it is about 91 days; in Lake Erie, the corresponding intervals are 76 days and 132 days respectively; for the other lakes, the intervals are somewhat less.

24. With the data which have been given, it is now possible to show what the practical result will be of an attempt to regulate the level of any lake within any given limits. For illustration, the Commission has selected the regulation of Lake Erie, between the limits 573·7 and 574·7, 1903 levels, by means of a submerged weir and sluice gates, as proposed by the Board of Engineers on Deep Waterways. In this case, the sluice gates cannot be set daily or at frequent intervals, to meet conditions as they arise, because of the difficulty of ascertaining what the true level of the lake is and what its consequent discharge is at any particular time. The irregularity and occasional violence of its oscillations make it necessary to take the average of a considerable number of observations—usually those of a month—to find the true level. The gates can, therefore, be set not oftener than once a month, and then only approximately. It is necessary to fix upon some definite elevation for the stage of the lake at the beginning of each month and then to set the sluice gates to give a discharge which will bring the lake to the level desired at the end of the month. That is to say, it is necessary to estimate the total supply which the lake will receive during the month to come. For regulation between the levels 573.7 and 574.7, the stage at the beginning of each month should be approximately as follows:

January 1	573·8	May 1	573·9
February 1	573·7	June 1	574·0
March 1	573·7	July 1 to November 1	574·0
April 1	573·8	December 1	573·9

In Table 33 are given the actual supply to Lake Erie, and the supply which would have been estimated if regulating works had been in operation for each month from January, 1890, to December, 1906, inclusive, and their difference. The table gives also the level which the lake would have reached with regulating works, and the difference between the stage reached and the stage desired. The actual supply and the stage are rarely identical with those expected, and in some cases the differences are important. For example, the actual supply in March, 1891, was 37,100 cubic feet per second less than would have been estimated, and in the following month, April, 1891, it was 47,800 cubic feet less than would have been estimated; the stage reached at the end of April, 1891, would have been 573·48, or 5 inches lower than the stage desired. In April, 1892, the supply was 40,200 cubic feet per second, and in the following month it was 29,400 cubic feet per second, more than would have been estimated, and the stage reached at the end of May would have been 574·54, or about 6½ inches higher than the stage desired. In July, 1892, the actual supply was 35,300 cubic feet per second less than would have been estimated. In June, 1892, the actual supply was 39,000 cubic feet per second less than would have been estimated, and in June, 1901, it was 32,300 more. Numerous other instances of important differences will be found in the table. They may occur in any part of the year. They show that it is not possible to foretell the stage under regulation, a month in advance, within 5 or 6 inches ; that is to say, that a margin of about 6 inches must be allowed at the upper and lower limits proposed for regulation. If the attempt be made to regulate within a range of one foot, with this margin, there will be no range left for setting the sluice gates, which is absurd. In other words, the regulation of Lake Erie within a range of 1 foot, or between the limits 573·7 and 574·7, is impracticable.

25. It appears, however, from a study of Table 33, that it would have been possible during the period covered by the table, 1890 to 1906, to regulate the level of the lake between the limits 573·31 and 574·74, or within a range of about 18 inches. This period covers the extreme low-water year, 1895, but not an extreme high-water year, like that of 1876. Computations were made to ascertain the effect of regulation between the limits 572·0 and 574·5 in the two extreme years. The results are given in Table 35, and shown graphically on Plate 21. It is found the extreme range from high water of 1876 to low water of 1895, which was 3·78 feet, would under regulation have been reduced to about 2·5 feet. The high levels of 1876 would not have been raised, but the low levels of November and December, 1895, would have been raised 1·38 and 1·37 feet, respectively, and the annual mean level of 1895 would have raised about 1·07 feet. This would benefit Lake Erie, and is, therefore, worthy of examination.

26. It must not be forgotten that these numbers refer to monthly mean or annual mean stages. It sometimes happens that the stage varies as much as 7 or 8 feet in one day, and more than 2 feet in one hour. Storms raise the water level, at Buffalo, several feet higher than normal, and lower it, at Amherstburg, by a like amount; the difference of level between the two ends of the lake in extreme cases having been as great as 15 feet. To control these irregular variations is impossible. It is possible only to regulate the monthly mean stage within the limits of about 2·5 feet. Whether or not it will be expedient to undertake the regulation of Lake Erie between these limits must depend upon the following considerations.

27. *Effect upon Lake Erie.* An examination of Plate 21 shows navigation. In 1895, a year of deficient supply, the mean level during the eight-month season of navigation would have been raised from 571·31 under natural conditions, to 572·41 under regulated conditions, and navigation would have been improved by an increase of 1·1 feet in the stage. The extreme low

stages for the navigation season would have been raised at least 1 foot without appreciable increase in the extreme high stage. This is equivalent to deepening every harbour and channel in Lake Erie by that amount.

28. *Effect upon Lake St. Clair.* The increase in the stage of Lake Erie will decrease the mean slope in the Detroit River, and will cause Lake St. Clair to rise, until the slope be so far restored as to give to the discharge through the Detroit River a value equal to the natural discharge. The amount which Lake St. Clair will rise on account of an increase of 1 foot in the stage of Lake Erie, is computed to be 0·61 foot. (See paragraph 121 of the Appendix.)

29. *Effect upon Lake Michigan-Huron.* As backwater from Lake Erie raises the level of Lake St. Clair, so backwater from Lake St. Clair raises the level of Lake Michigan-Huron. The effect of an increase of 0·61 foot in the stage of Lake St. Clair is to raise the level of Lake Michigan-Huron 0·27 foot. (See paragraph 123 of the Appendix.)

30. *Effect upon Lake Ontario, and the St. Lawrence Canals.* Any change in the outflow of Lake Erie will change the water levels of Lake Ontario. If the inflow to Ontario is increased, the lake level will rise, and with decreased inflow the level will fall. For the extreme years, 1876 and 1895, the effect upon Lake Ontario of the regulation of Lake Erie is shown in Table 36, and on Plate 21. For the high water year, 1876, there would have been but little change; at no time during the year would the regulated stage of Lake Ontario differ from the actual stage more than 1½ inches. In 1895, the low water year, the oscillation would have been increased. The high water of May would have been about 1 inch higher, while the low water of September, October, and November, would have been 4·08, 4·46 and 4·00 inches, respectively, lower under regulation than under the natural conditions. To lower the level of Lake Ontario is to lower the St. Lawrence River and to injuriously affect navigation in the St. Lawrence canals. A comparison of the gauge records upon Lake Ontario and at these canals shows that of 4·56 inches in the level of Lake Ontario will lower the level in the Galop canals about 4·56 inches, in the Morrisburg canals by about 6·65 inches, and in the Iroquois Canal, Lock 25, by about 7·66 inches. During periods of low-water it would be necessary to diminish the draft of vessels navigating the canals about 7·66 inches, by decreasing their loads.

31. *Effect upon Niagara River.* The effect upon Niagara River would not be important. The stage would not fluctuate through any greater range than under natural conditions. During the winter months, more frequent low water would probably occur, in which case the power companies at Niagara Falls would probably have more difficulty in keeping the channels to their intakes free from ice. During the autumn months navigation might be slightly injured by the prolongation of the low-water season, due to the storage in Lake Erie of a part of the natural discharge.

32. *Effect upon the City and Harbour of Buffalo.* Low-lying portions of the City of Buffalo and the adjacent territory are subject to overflow both from the lake and from tributary streams, especially Buffalo Creek. Floods from the lake are due to storms blowing from the southwest. During the severe storm of January 20, 1907, Lake Erie rose to 579·45, or 6·49 feet above the mean for that month, or 7·0 feet above the mean of the preceding and following months. Iron furnaces were extinguished, a pumping plant was seriously crippled, and much damage was inflicted upon the lands and property in Buffalo adjacent to the lake and to Buffalo Creek. Under regulation, the monthly mean level of the lake upon that occasion would have been about 2½ inches higher than it was and the height of the flood would have been increased by that amount. Floods from Buffalo Creek are now of common occurrence. With a few days of warm

weather in the winter, the discharge of the creek becomes so great as to overflow its banks, and the water sometimes floods an area of 1,600 acres, having a population of 10,000. It is stated by the Department of Public Works of Buffalo that a rise of 2 feet in the stages of the lake causes a rise of about 1 foot in Buffalo Creek in the center of the flood district. Most of the floods in Buffalo Creek occur during January, February, and March, when Lake Erie is at its lowest stage. Some of the greatest floods have occurred during the extreme low-water periods, such as those in the winters of 1896, 1898, 1900, and 1902. With the winter level regulated at a height greater than it actually was upon those occasions, the flood height would have been increased, and greater damage would have occurred.

33. *Ice Jams.* During every winter ice jams form on Horseshoe Reef at the Head of Niagara River. The ice in the lake is blown toward the outlet by a southwest wind, and is piled upon the shallow reef, where it forms an ice jam extending from near the bottom to several feet above the surface of the water. In some instances, the bergs have been 20 to 30 feet high. The proposed regulating works, being placed about a mile below Horseshoe Reef, would aggravate this difficulty. The neck of the outlet might become so effectively blocked with ice that the flow of the river would be materially decreased as was the flow of the St. Clair River in the winters of 1901 and 1902. If those conditions should exist, a severe southwesterly storm, such as has occurred on numerous occasions, would inundate the lower part of Buffalo. These ice jams seriously interfere with navigation. The average date of opening navigation in the spring, at Buffalo, is April 9, while at Cleveland, the average date is March 23. The difference of 17 days in the dates of opening the two Lake Erie ports is due to ice jams. It is probable that it would be materially increased by the construction of the regulating works. It is to be observed that the ice jams would make it difficult to maintain the works.

34. *Effect upon the Low-lying Shores of Lake Erie.* There are low-lying portions of the shores of Lake Erie where the water is shut out by dykes and where pumping is now required. To raise the level of the lake would increase the amount of such pumping. It is possible, also, that there are points other than Buffalo, where great commercial interests are concentrated, and where local drainage is deficient, but for reasons which will appear presently it has not been considered necessary to make a detailed investigation of every locality.

35. The advantages then of regulating Lake Erie, between the limits 572·0 and 574·5, are that the low-water stages of Lake Erie will be raised about 1 foot; those of Lake St. Clair will be raised about 0·61 foot; and those of Lake Michigan-Huron, about 0·27 foot; without in any case increasing the high water stage.

36. The disadvantages are that the oscillations in Lake Ontario are increased about 5½ inches, and low water is made lower by about 4½ inches; that the depth in the St. Lawrence canals will be diminished by about 7·66 inches; that the city of Buffalo and its southerly suburbs will suffer by increased damage from floods, and from a postponement of the date of opening navigation in the spring.

37. In weighing these advantages and disadvantages, it is to be remembered that the persons who are to benefit by the former are not identical with those who are to suffer from the latter. Those navigating the St. Lawrence canals are not specially concerned with deepening the harbours of Lake Erie; not are those occupying the low-lying portions of Buffalo sufficiently compensated for the injury to their property by the beneficial effects upon navigation. If the advantages and disadvantages could be equally distributed, we are inclined to think that the former would outweigh the latter, and that the expediency of the undertaking would be a question of cost. As the matter stands, it involves the question of damages to vested rights, which in this case is peculiarly intricate. It is our opinion that the advantages are not of such overwhelming character as to

justify the two governments in entering upon that vexations question, and we therefore recommend that the "regulation" of Lake Erie be not undertaken, meaning thereby the most complete practicable regulation such as can be secured by a dam and sluice gates at or near Buffalo.

38. It does not follow that nothing can advantageously be done to improve or maintain the level of the lake. It is possible to raise the level of any lake by simply reducing the size of the outlet. With a reduced cross section, the outlet requires a steeper slope, and the average level of the lake is raised, but the oscillations will go on as before, and the discharge will remain the same. To raise the level of Lake Erie will raise, also, but to a less degree, the levels of Lake St. Clair and of Michigan-Huron, and will thus benefit those waters, while it will have no effect upon Lake Ontario or the St. Lawrence River. It would be physically practicable to raise the level many feet, but here again vested rights must be considered, and the amount which the level should be raised is in our judgment limited to that which will not interfere with those rights.

39. It is believed that somewhere in the Niagara River, between Lake Erie and the Falls, a submerged dam may be placed which will greatly benefit the navigation of the waters above without injury to those below and with only minor damages, if any, to the adjoining lands. Without any attempt to 'regulate' Lake Erie, the level of the lake may be raised sufficiently to compensate for the damages heretofore inflicted by the Chicago Drainage Canal and other deteriorating influences. To distinguish works of this kind from those designed to 'regulate' the lake, they may be called 'compensating' works.

40. The upper Niagara River is a valuable safety-valve for the protection of Buffalo from the effects of storms upon Lake Erie, and should not be obstructed by a dam. It is possible that the extreme lower end of the reach, that is, the section just above the Falls, may not be available because of excessive overflow to be caused in the valley of the Welland River. To determine the best site it has been necessary to make additional surveys. These were begun in July, 1909, and are still in progress. After their completion it is our intention to submit a supplementary report upon the subject.

41. In connection with the hydraulic analysis of the general regulation of all the lakes, attention is invited to a discussion of the regulation of Lake Superior of Lake Michigan-Huron, and of Lake Ontario, which will be found in the Appendix, paragraphs 125-132, 148-155. Without going into details it may be stated in general terms, that, as in the case of Lake Erie, only a very moderate degree of improvement in regulation over what nature provides is practicable in any of the lakes, and that, such as it is, this improvement is obtained at the expense and to the injury of the navigable channels below. If the level of any lake has been lowered, whether by diversion through the Chicago Drainage Canal or by enlargement of the outlet, the remedy seems to lie in 'compensating' rather than in "regulating" works.

42. Attention is invited also to a discussion of the use of Lake Superior as a a reservoir, which has been proposed by persons not familiar with the Great Lakes, to compensate for the diversion of water through the Chicago Drainage Canal (see Appendix, paragraphs, 133-147). The result of the discussion is to show: 1, that Lake Superior, being naturally one of the greatest and best regulators of flow to be found in the world, maintains a flow in the St. Mary's River, its outlet, which is remarkably uniform; 2, that uniformity of flow in that river is essential to the best interests of navigation of the river itself; 3, that during the winter months when navigation is suspended this uniformity of flow is still necessary to maintain the level of Lake Huron, and keep it in condition to maintain in its turn the St. Clair and Detroit Rivers in the spring when navigation opens. It is not in the power of man to improve this uniformity of flow to any important degree. He may disturb it, making it less uniform,

by storing water in Lake Superior, but any water withheld at one season would create a deficiency in the lake below, which must be replaced by an equivalent increase of discharge from Lake Superior at another season. This would simply increase the oscillations in the level of the lakes below, that is, would injure them, without compensating in any degree for the diversion of water through the Chicago Drainage Canal.

GEO. C. GIBBONS,
Chairman, Canadian section.

LOUIS COSTE,
Member, Canadian section.

W. J. STEWART,
Member, Canadian section.

O. H. ERNST,
Brig. Gen'l, U.S. Army, Retired,
Chairman, American section.

GEORGE CLINTON,
Member, American section.

E. E. HASKELL,
Member, American section.

Attest:
W. EDWARD WILSON,
Secretary, American Section.

The Minister of Public Works of Canada.
The Secretary of War of the United States.

APPENDIX.

International Waterways Commission.
Office of American Section.
Buffalo, N.Y., December 4, 1909.

The International Waterways Commission:

Your committee, which was appointed to investigate the advisability of locating a dam at the outlet of Lake Erie (as proposed by the Board of Engineers on Deep Waterways) and the maintenance and regulation of suitable levels on the other lakes in the Great Lakes system, now has the honour to report upon these subjects. It is hoped that this investigation will be of assistance to the Commission in considering the subjects mentioned above.

THE GREAT LAKES.

1. The Great Lakes, comprising Lakes Superior, Michigan, Huron, Erie, and Ontario, situated between the United States and Canada, differ from the high seas in that the latter have diurnal tides while the former have periodic and seasonal stage cycles. Lake Superior, the largest of these lakes, has a length, from Duluth to Point Iroquois, of 383 miles and a breadth of approximately 160 miles. Its maximum recorded depth is 1012 feet. The outlet of this lake is the St. Marys River. The length of Lake Michigan is approximately 321 miles;

its breadth, 118 miles, and its maximum measured depth 870 feet. Lake Huron is about 220 miles long and 101 miles wide, with a maximum measured depth of 750 feet. Lakes Michigan and Huron are connected by the Strait of Mackinac, and their outlet is the St. Clair River. Lake St. Clair is approximately 26 miles long and 24 miles wide; its maximum depth is less than 24 feet, except at the head of the Detroit River, the outlet of the lake. Lake Erie is about 240 miles in length, with a maximum width of 57 miles; its maximum depth, as recorded by the U.S. Lake Survey, is 210 feet. Niagara River is the outlet of this lake. Lake Ontario is about 190 miles long, 57 miles wide, and has a maximum recorded depth of 730 feet. The present natural outlet of this lake, as well as of the entire Great Lakes system, is the St. Lawrence River.

AREAS OF THE SEVERAL LAKES AND WATERSHEDS OF THE GREAT LAKES SYSTEM.

2. The areas of the surfaces of the Great Lakes and their watersheds, as determined by the United States Lake Survey, are shown in Table 1.

TABLE I.

Lake.	Area of Lake Surface in Square Miles.	Drainage Area, Including Lake Surface in Square Miles.	Ratio of Lake to Land Area.
Superior	32,060	76,134	1 1·37
Michigan	22,336	65,799	1 1·95
Huron	22,978	72,008	1 2·13
Michigan-Huron	45,314	137,807	1 2·04
St. Clair	503	6,194	1 11·31
Erie	9,968	34,573	1 2·47
Ontario	7,243	32,980	1 3·55

Authority: 1906 United States Lake Survey report. (Unpublished).

3. The land area for any watershed is considered as the difference between the total drainage area and the area of the lake surface. The areas of the small lakes and streams are taken as a part of the land area.

4. The ratio of lake to land area is least for Superior and greatest for St. Clair, and increases with each succeeding lake lower in the system, St. Clair excepted.

WATER-LEVEL RECORDS OF THE GREAT LAKES AND THEIR CONNECTING RIVERS.

5. Beginning about 1860 and continuing to date, daily or tri-daily water-level observations have been taken on the several lakes and connecting channels of the Great Lakes. These readings have been reduced to monthly mean stage by determining the average for the month. In 1899, the first self-registering automatic gauges, giving a continuous graphical record of the rise and fall of the water, were installed. The water-level records tabulated in this report pertain directly to the stage of the waters of the Great Lakes system. In nearly every instance, they have been placed at the service of the Commission through the Chief of Engineers' reports, or have been obtained from the United States Lake Survey.

6. Marquette. The elevation of the water surface of Lake Superior above mean tide at New York was observed at Superior, Wis., for the period from 1860 to 1871, inclusive, while from 1872 to 1907, inclusive, it was observed at Marquette, Mich. The self-registering gauge, located at Marquette, was placed in operation in November, 1902. During the forty-eight years of observations, there were months when no records were taken. For the years 1860 and 1861, missing values have been supplied by adding (algebraically) to the observed reading of the following or preceding month the monthly mean rise or fall of water surface from 1860 to 1871, inclusive. Missing values in the period from 1871 to 1888, inclusive, have been supplied by adding to Sault Ste. Marie, Mich., readings the monthly mean fall from Marquette to Sault Ste. Marie for that period. Missing values for the period from 1889 to 1901, inclusive, have been supplied from the Sault Ste. Marie readings by applying to these readings the monthly mean fall from Marquette to Sault Ste. Marie for that period. The stage of Lake Superior, from 1860 to 1907, inclusive, at Marquette, Mich., and Superior, Wis., is given in Table 2.

7. Sault Ste. Marie. The monthly mean stage of the St. Marys River, the outlet to Lake Superior, was observed at the southwest pier, Sault Ste. Marie, Mich. (above the locks) from November, 1870, to December, 1907, inclusive. Before November, 1899, the readings were taken with a staff gauge, but since that time a self-registering gauge has been in operation. To make the records complete from January, 1860, to October, 1870, inclusive, the mean monthly fall from 1871 to 1888, inclusive, from Marquette, to Sault Ste. Marie, has been substracted from the corresponding Marquette readings. These monthly mean stages at Sault Ste. Marie (above the locks) are given in Table 3.

8. Milwaukee. The water-level records giving the stage of water of Lake Michigan, from 1860 to 1907, inclusive, were taken at Milwaukee, Wis. The monthly mean elevations of water surface are given in Table 4.

9. Harbor Beach. From September ,1874, to December, 1907, inclusive, the stage of Lake Huron was observed at Harbor Beach, Mich. (formerly Sand Beach). From April, 1901, to December, 1907, inclusive, the stage was recorded by a self-registering gauge. The water levels from January, 1860, to August, 1874, inclusive, were derived by the United States Lake Survey, (see page 4105, appendix EEE, annual report of the Chief of Engineers for 1904), as follows: January, 1860, to September, 1864, inclusive, from observations at Point aux Barques; and October, 1864, to August, 1874, inclusive, from observations at Port Austin. These water levels for Lake Huron stage, from 1860 to 1907, inclusive, are given in Table 5.

10. G.T.R. Water-level observations have been taken near the head of the St. Clair River, at G.T.R. (Grand Trunk Railway) from March, 1899, to December, 1907, inclusive. The computed G.T.R. monthly mean gauge readings from January, 1860, to February, 1899, inclusive, were derived from the relation deduced between the monthly mean stage at Harbor Beach and Grand Trunk Railway, from March, 1899, to December, 1904, inclusive. The equations are: for assumed open season, from April to December, (G.T.R.—578) = 0·889 (Harbor Beach—578)—0·529, and for the winter season of January, February and March, (G.T.R.—578) = 0·889 (Harbor Beach—578)—0·235. The actual observations showed that during the average open season the fall from Harbor Beach to G.T.R. remained practically constant for the same stage slightly with increasing stages of Lake Huron, while during the winter months the fall decreased materially but also increased slightly with increasing stages of the lake. The G.T.R. gauge data are shown in Table 6.

11. St. Clair Flats Canal. In July, 1872, the first authentic records of the stage of Lake St. Clair were taken at the St. Clair Flats Canal. These readings were recorded continuously up to December, 1907, inclusive, with the

exception of October, 1877; April and May, 1878; June, 1879, to August, 1881 inclusive; November, 1881, to April, 1882, inclusive; June, September, and October, 1882; December, 1882, to April, 1883, inclusive; January to March, 1902, inclusive; February to April, 1903, inclusive; January, 1906, to October, 1906, inclusive; and August, 1907, to December, 1907, inclusive. From January, 1860, to June, 1872, inclusive, no observations were taken. Values for the missing monthly mean water levels at St. Clair Flats Canal for January, 1861, to July, 1865, inclusive; January, 1866; April and May, 1878, and June, 1879, to August, 1881, inclusive, have been deduced from the monthly means of observations taken simultaneously at St. Clair Flats Canal, the Light-house Depot, Detroit, Mich. (see 1868 United States Lake Survey report in report of the Secretary of War, Fortieth Congress, third session, Vol. 2, 1868-69, p. 985), and Amherstburg, Ont., from which the derived relation between fall from Light-house Depot to Amherstburg, and fall from St. Clair Flats to Amherstburg has been determined. The equation expressing this relation is: (Fall St. Clair Flats to Amherstburg, = 1·0357 (Fall Light-house Depot to Amherstburg) + 0·377. Those missing for January, 1868, to March, 1868, inclusive; January, 1869, to March, 1869, inclusive; December, 1869, to March, 1870, inclusive; January and February, 1871; and December, 1871, to March, 1872, inclusive, have been derived from the monthly means of observations taken simultaneously at St. Clair Flats Canal, Old Detroit Waterworks, located at the foot of Orleans Street, Detroit, Mich. (see Forty-ninth regular report of the Board of Water Commissioners to the Common Council of the city of Detroit, 1901), and Amherstburg, Ont., from which has been derived the relation between the fall from St. Clair Flats to Old Detroit Waterworks, and fall from St. Clair Flats to Amherstburg. The derived equation is: (Fall St. Clair Flats to Amherstburg, =0·9378 (Fall Old Detroit Waterworks to Amherstburg) + 0·853, Those missing for August 1865, to December, 1865, inclusive; February, 1866, to December, 1867, inclusive; April, 1868, to December, 1868, inclusive; April, 1869, to November, 1869, inclusive; April, 1870, to December, 1870, inclusive; March, 1871, to November, 1871, inclusive; April, 1872, to June, 1872, inclusive; and October, 1877, have been derived independently from Light-house Depot observations and from Old Detroit Waterworks' records taken at the foot of Orleans Street, Detroit, Mich., as previously explained. The mean of the two derived values has been used for St. Clair Flats. For all months of the year 1860, the St. Clair Flats values (as given on p. 4097, United States Lake Survey report of 1904) have been reduced by 0·67 foot, so as to obtain the original readings taken at the Old Detroit Waterworks, foot of Orleans Street, which were not available. From the original readings thus obtained, new values for stage at St. Clair Flats Canal have been derived by the fall method previously described. The value 0·67 foot represents the mean fall from St. Clair Flats Canal to Old Detroit Waterworks, as deduced on p. 4082 of the United States Lake Survey report for 1904. The derived values for November, 1881, to April, 1882, inclusive; June, September, and October, 1882; and December, 1882, to April, 1883, inclusive, have been obtained by first subtracting 0·48 foot (0·477) from the New Detroit Waterworks' readings and then applying the mean monthly fall from St. Clair Flats to New Detroit Waterworks, as deduced from observations taken at those points from January, 1889, to June, 1901, inclusive. The value referred to above (0.48 foot) represents the discrepancy in the elevation of the zero of the New Detroit Waterworks' gauge, as determined about 1878 and during the period from 1893 to 1897. In the forty-ninth regular report of the Board of Water Commissioners of Detroit, it was assumed that the error occurred when the gauge was moved and that it had remained at a constant elevation from January, 1878, until 1893. A comparison of these data with those taken simultaneously at St. Clair Flats Canal indicates that the change occurred after May, 1889. Those for January to March, 1902, inclusive; February to April, 1903, inclusive; January to October, 1906, inclusive; and August to December, 1907, inclusive, have been derived from the observations taken at Windmill Point, Lake St. Clair, by applying the mean monthly fall from St. Clair Flats Canal to Windmill Point, as determined from simultaneous observations taken at those points from January, 1897, to July, 1907, inclusive. The monthly mean levels of Lake St. Clair, at St. Clair Flats Canal, are given in Table 7.

12. Windmill Point. Water-level readings have been taken at Windmill Point, near the outlet of Lake St. Clair, by the United States Lake Survey, from 1897 to 1907, inclusive, with the exception of February, 1898, and May and June, 1902. The monthly mean stage values from January, 1860, to December, 1896, inclusive, and for the three missing months mentioned above, have been derived from the St. Clair Flats Canal readings by applying to those values the mean monthly fall from St. Clair Flats Canal to Windmill Point, as determined from simultaneous observations made at those points from January, 1897, to July, 1907, inclusive. The monthly mean values at Windmill Point are given in Table 8.

13. Amherstburg. For several years, commencing with July, 1899, water-surface readings have been taken at the foot of the Detroit River, by which a good relation has been obtained between the water levels at Cleveland, Ohio, and Amherstburg, Ont. The values from January, 1860, to June, 1899, inclusive, and July to December, 1907, inclusive, were derived by applying to the Cleveland, Ohio, readings the mean monthly fall from Amherstburg to Cleveland, as determined from simultaneous observations at those places from July, 1899, to December, 1904, inclusive. The Amherstburg monthly mean water-surface readings are shown in Table 9.

14. Cleveland. Water-level readings of Lake Erie have been taken at Cleveland, Ohio, from 1860 to 1907, inclusive, with the exception of January, 1877, and October, 1880, to March, 1881, inclusive, which values have been supplied by applying to the monthly mean values for Erie, Pa., the corresponding yearly mean difference of stage between Erie and Cleveland. The values from January, 1860, to December, 1903, inclusive, have been taken from the United States Lake Survey report for 1904, beginning with p. 4097. Those from January, 1904, to December, 1907, inclusive, have been taken from the United States Lake Survey annual reports. These monthly mean water levels of Lake Erie, at Cleveland, Ohio, are given in Table 10.

15. Buffalo. All of the water-surface records taken at Buffalo, prior to March, 1887, were accidentally destroyed, and values have been derived from Cleveland readings by applying to such readings the mean monthly fall from Cleveland to Buffalo as derived from simultaneous observations taken at those places from June, 1899, to December, 1906, inclusive. Values for January and February, 1901, and December, 1902, have been supplied in the same way. From 1888 to 1898, inclusive, the monthly means have been derived from the U. S. Lake Survey tables by subtracting 0.1 foot from the records there given. This correction has been determined by a comparison with Cleveland of the mean of the three months, June, July, and August, for each year during this period. From March, 1899, to December, 1907, inclusive, the gauge records have been taken with a self-registering automatic gauge, located at the Buffalo Breakwater Light-house. The monthly mean elevations of Lake Erie, at Buffalo, N. Y., from 1860 to 1907, inclusive, are given in Table 11.

16. Charlotte. Water-level readings of Lake Ontario have been taken at Charlotte, N. Y., from January, 1860, to October, 1907, inclusive. In 1906, the United States Lake Survey's automatic gauge was destroyed and since that time has not been replaced. These monthly mean water-surface elevations of Lake Ontario at Charlotte, N. Y., are given in Table 12.

17. OSWEGO. Water-level observations have been taken at Oswego, N.Y., from 1860 to 1907, inclusive. These water levels give the true elevations of Lake Ontario for that period, with the possible exception of some spring months when the Oswego River is at flood stage. These water-surface elevations of Lake Ontario, at Oswego, N. Y., are given in Table 13.

18. OGDENSBURG. The water-level records of the St. Lawrence River, taken at Ogdensburg, N. Y., are very incomplete. The missing monthly means for Ogdensburg have been derived from Oswego readings by use of the following equation, which has been derived from monthly mean levels at those two places, as deduced from simultaneous observations: (Ogdensburg − 240) = 0·9426. (Oswego—240)—0·553. The St. Lawrence River water levels, at Ogdensburg, are shown in Table 14.

19. LOCK 27. The Canadian Government has observed the stage of water on the sills of the several locks in the St. Lawrence canals for many years. The observations taken at Lock 27, which is located at the head of Galop Rapids in the St. Lawrence River, date from January, 1875, and are complete to December, 1907, inclusive, with the exception of June, 1878, February, 1880, and August and September, 1890, the values for which have been derived from Oswego values, using the following formula: (Lock 27—240) = 0·9457 (Oswego—240)—1·845. For the period from January, 1860, to December, 1874, inclusive, the water-level values have been derived from Oswego, N. Y., readings according to the above formula, which assumes a mean-fall relation between Oswego and Lock 27 during that period. Table 15 gives the monthly mean water-level records of the St. Lawrence River, at Lock 27, head of Galop Rapids, from 1860 to 1907, inclusive.

20. LOCK 24. The water-level readings at Lock 24 have been observed from January, 1880, to December, 1907, inclusive, and are complete with the exception of February, 1880, April and May, 1882, and May, 1890. Lock 24 is located at the head of the Morrisburg Canal. This canal was built along a portion of the north shore of the St. Lawrence River, and provides a 14-foot navigable channel around the Rapide Plat. Table 16 gives the monthly water levels at Lock 24, head of Rapide Plat, St. Lawrence River, from January, 1880, to December, 1907, inclusive.

21. LOCK 21. The stage observations taken at Lock 21, the upper entrance to the Cornwall Canal and at the head of the Long Sault Rapids in the St. Lawrence River, were begun January, 1870, and are complete to December, 1907, inclusive, with the exception of September, 1882. The monthly mean water-surface readings at Lock 21, Cornwall Canal, head of Long Sault Rapids, St. Lawrence River, are given in Table 17.

22. Plate 1 shows the monthly mean stage of Lakes Superior, Michigan-Huron, St. Clair, Erie, and Ontario from 1860 to 1907, inclusive.

NOMENCLATURE.

23. The following abbreviations and terms are used in this report:
S = Total supply to any lake, in cubic feet per second.
R = Run-off from watershed, in cubic feet per second.
D = Discharge of lake's outlet, in cubic feet per second.
E = Evaporation from lake surface, in cubic feet per second.
P = Precipitation on lake surface, in cubic feet per second.
I = Inflow or transmitted supply from lake above, in cubic feet per second.
L = Local supply, or supply from lake's own drainage area, in cubic feet per second.
s = Storage on lake surface, in cubic feet per second, (positive or negative).
A = Area of lake, in square feet.

h = Depth, in feet, on lake surface, measured from any datum.
t = Time, in seconds, for one-twelfth of a year.
i = Increment, or rate of change of discharge in cubic feet per second per foot change in stage.
u = Coefficient.
g = Acceleration due to gravity, = 32·2 feet per second.
b = Width of section, or length of crest of submerged weir in feet.
h_U = Head, in feet, on crest of submerged weir, measured from upstream side.
h_D = Head, in feet, on crest of submerged weir, measured from downstream side.
F = Fall in stream, expressed in feet.
C = Coefficient.
V = Mean velocity, in feet per second.
k = Theoretical velocity head, in feet, = $V^2 \div 2g$.
h_S = Height of swell, in feet.
d = Mean depth, in feet.
$R_{MAX.}$ = Ratio between the maximum value of mean monthly discharge and the maximum value of mean monthly total supply to any lake.
$T_{MAX.}$ = Time interval in days between the date of the occurrence of the maximum value of mean monthly total supply to any lake and that of the maximum value of mean monthly discharge from that lake.
$T_{MIN.}$ = Time interval in days between the date of the occurrence of the minimum value of mean monthly total supply to any lake and that of the minimum value of mean monthly discharge from that lake.

GENERAL EQUATION FOR STREAM FLOW.

24. The discharge equations of all rivers in the Great Lakes system, with the exception of the St. Marys River, have been derived by use of a submerged-weir formula. Each river bed has been assumed to represent a submerged weir with a broad, flat, crest, whose upstream and downstream faces are of considerable length. The location of the submerged weir has been assumed to be at or near the critical cross section, which is generally at the head of the river. The submerged weir formula is generally recognized in one of the following two forms:

$$D = u\frac{2}{3}b\sqrt{2g}\,(h_U - h_D)^{\frac{3}{2}} + ubh_D\sqrt{2g}\,(h_U - h_D)^{\frac{1}{2}} \qquad (1)$$

$$D = u\frac{2}{3}b\ \overline{2g}\,\left(^{h_U} + \frac{h_D}{2}\right)\,(h_U - h_D)^{\frac{1}{2}} \qquad (2)$$

where h· represents the depth on the average elevation of the crest of the weir, measured from the upstream side.
h_D: the depth on the average elevation of the crest of the weir, measured from the downstream side, and
b, the length of the weir crest in feet. The quantity, $(h_U - h_D)$, represents the fall (F) in the stream, or the difference between the upstream and downstream heads. The quantity, $u2/3b\sqrt{2g}$, taken as a whole, represents a variable coefficient (C) which has been derived for each river and is applicable only to that river. This submerged-weir formula reduces to the form,

$$D = CF^{\frac{1}{2}}\left(^{h_U} + \frac{h_D}{2}\right) \qquad (3)$$

and was so used in deriving the discharge equations of the several rivers. For every measurement of river discharge, all factors are known, with the exception of the coefficient, which has been derived. Knowing the way in which the coefficient for each river varies according to the upstream and downstream head, it is a comparatively simple matter to compute the discharges of the several outlets according to the proper formula. On the St. Clair, Detroit, and St. Lawrence Rivers, the coefficients vary as a function of the upstream and downstream head on the submerged weir. The curve used, showing the manner in which C varies, is the equilateral hyperbola, with its asymptotes parallel to the co-ordinate axes. It is:

$$C = \frac{y}{1 + \frac{x}{h_U}} \tag{4}$$

in which C is the coefficient depending on h_U or h_D, the upstream or downstream head, respectively.

x and y are constants, which represent the distance of the asymptotes from the y and x axes, respectively.

For convenience in deriving the unknown values, this hyperbolic equation has been transferred into a straight line equation by dividing by y, which gives

$$C = \frac{1}{\frac{1}{y} + \frac{x}{yh_U}} \tag{5}$$

and then taking the reciprocal of each member.

$$\frac{1}{C} = \frac{1}{y} + \frac{x}{y}\left(\frac{1}{h_U}\right) \tag{6}$$

DISCHARGE OF ST. MARYS RIVER, OUTLET TO LAKE SUPERIOR.

25. The St. Marys River, from Point Iroquois, in Lake Superior, to the head of the United States Ship Canal, at Sault Ste. Marie, Mich., is a wide stream with comparatively little slope, there being about two-tenths of a foot fall in this distance. At the latter location, rapids (about one-half a mile in length) connect the upper and lower St. Marys River. The submerged weir of rock at the head of these rapids controls the discharge of water from Lake Superior, and any change in this submerged weir would cause a change in the volume of discharge for the same stage. Any auxiliary channel connecting with the pool immediately above the weir would increase the river discharge for the same stage by the volume thus diverted. During the epoch, 1860 to 1907, inclusive, the regimen of the St. Marys River, above the rapids, was changed on several occasions. In 1887 and 1888, the International Bridge across the St. Marys Rapids was constructed. Prior to that time, the river discharged at the bridge site through four channels, viz., the main rapids and three small streams situated between the islands lying adjacent to the north shore. The building of the bridge piers and approaches and the filling in of portions of the three small streams (called *a*, *b*, and *c*) on the north side of the main channel reduced the effective area at this critical discharge cross section so that the flow of the St. Marys River was materially decreased.

26. In 1889, the Canadian Water Power Company (now the Lake Superior Power Company) commenced work on a power plant and used for its canal the northerly of the three small streams (*c*) previously mentioned. The flow therein was practically stopped until the latter part of 1895, when this power plant was opened. During the year 1892, the Edison Sault Electric Light & Power Company (now the Chandler-Dunbar Water Power Company) built a dyke from the second pier on the American side of the International Bridge, parallel to the shore, for a distance of about 1,500 feet down the stream. The

area inclosed by the American shore and this dyke is used as a forebay by the power company practically shutting off from the main channel the flow through these two spans. By December, 1892, the flow of the river had been restricted by the building of the piers and approaches to the International Bridge, the shutting off of spans 1 and 2 from the main channel on the American side, and the closing of stream *e* on the Canadian side. Beginning in December, 1895, the Lake Superior Power Company started the operation of its plant on a large scale, using water at the rate of approximately 3800 cubic feet per second. This power plant has been in continuous operation since then, with the exception of February and March, 1896, and has gradually increased the quantity of water used until it now reaches about 6,000 cubic feet per second. The use of water by the American and Canadian locks has also increased from time to time until it now amounts to an average flow of about 600 cubic feet per second. In 1901, the Michigan Lake Superior Power Company started work on the construction of a compensating works in the rapids of the St. Marys River, about 300 feet above the International Bridge. These works practically shut off the entire flow through spans 9 and 10 the first two spans on the Canadian side of the river. In January, 1905, the Michigan Lake Superior Power Company began to divert water through its canal, using about 8500 cubic feet per second at that time.

27. DISCHARGE MEASUREMENTS. During the winter of 1896, discharge measurements of the St. Marys River were taken by the United States Government at Spry's Dock Section, located about a mile below the St. Marys Rapids. The discharge equation deduced from these observations, modified for the various efflux conditions, has been the governing factor for the determination of the outflow of Lake Superior from January, 1860, to September, 1901, inclusive. The derived equation is:

$$D_{\text{RIVER}} = 18826\ (\text{Southwest Pier Gauge} - 600) + 37060. \qquad (7)$$

See 1906 United States Lake Survey report (unpublished).

28. The Southwest Pier Gauge is located at the southwest pier above the American locks at Sault Ste. Marie, Mich. At the time that these measurements were taken, the Chandler-Dunbar Water Power Company was using 1065 cubic feet of water per second through its works; streams *a* and *b* on the north side of the main channel were still open, and the Lake Superior Power Company's plant was closed.

29. In 1902, the United States Lake Survey measured the flow through the St. Marys Rapids at the International Bridge, which connects Sault Ste. Marie Mich., with Sault Ste. Marie, Ont. The discharge equation derived from these observations gives the flow through the rapids after spans 9 and 10 (the first two spans on the Canadian side) were closed by the construction of the compensating works of the Michigan Lake Superior Power Company. It is:

$$D_{\text{RAPIDS}} = 15540\ (\text{Southwest Pier Gauge} - 600) + 30510. \qquad (8)$$

30. During February and March, 1905, observations of the flow in the St. Marys River were taken at "Section Brewery," located about 2000 feet below the Spry's Dock Section. The discharge equation derived from these measurements is:

$$D_{\text{RIVER}} = 18484\ (\text{Southwest Pier GaugeÆ} - 600) + 41829. \qquad (9)$$

This formula gives the total flow of the river, while that derived from the 1902 measurements gives only the flow through the St. Marys Rapids.

31. *St. Marys River Discharge Formulæ, as Used for the Different Efflux Conditions.*—The discharge formula governing the first period, 1860-1888, inclusive, was derived from the measurements made in 1896 and 1902 (the fifth and tenth periods of efflux) in conjunction with hydraulic data taken at the International Bridge Section in 1901 and 1902. The mean stage of the

St. Marys River at the Southwest Pier (above the locks), Sault Ste. Marie, Mich., from 1871 to 1905, inclusive, was 601·86 feet above mean tide at New York. The 1896 discharge measurements give: $D_{\text{RIVER}} = 18826$ (Southwest Pier Gauge − 600) + 37060. The discharge of the river at mean stage was 72076 cubic feet per second. Deducting from this value 1065 cubic feet per second (the amount of water used by the Chandler-Dunbar Water Power Company) and 1798 cubic feet per second (the discharge of two small streams on the north side of the rapids) gives the flow through the main channel of the St. Marys Rapids as 69200 cubic feet per second. From the vertical and transverse percentage velocity curves deduced from observations made at the Bridge Section, for spans 3-10, inclusive, in 1901, and for spans 3-8, inclusive, in 1902, the ratio of flow of the entire cross section to that for any partial section has been determined. These curves show the modification in the transverse velocity curve due to the construction, by the Michigan Lake Superior Company, of the compensating works located about 300 feet above the bridge. With these data, the transverse percentage velocity curve at the International Bridge Section, for the first period, has been constructed for the entire main channel, which included the channels for spans 1 and 2 of the bridge, next the American shore. This curve has been integrated and its mean ordinate, or mean percentage velocity computed. The product of this value and the mean velocity of the rapid's flow at mean river stage under the 1896 conditions, or during the fifth period of efflux, gives the mean velocity for the main channel under the original conditions or for the first period of efflux. The product of the mean velocity and the area of the cross section before the bridge was built gives the discharge of the main channel for mean river stage. The equations giving the actual computations are:

$$D_1 = A_1\left(\frac{D_5}{A_5} \times \text{mean percentage } V_1\right) = A_1 V_1 \qquad (10)$$

$$= 13690\left(\frac{69200}{10650} \times 0.925\right) = 13690 \times 6.01 = 82280 \text{ cubic feet}$$

per second, discharge of main channel for mean river stage under original conditions.

32. With the volume of flow known for mean river stage, the only remaining step is to derive the increment of discharge per foot change in stage. In deriving this increment, use has been made of Bernouilli's theorem applied to open channels with steady flow, expressed as follows:

$$\text{Friction head} = F + \frac{V^2_{\text{UPSTREAM}}}{2g} - \frac{V^2_{\text{DOWNSTREAM}}}{2g} \qquad (11)$$

33. It has been assumed that the friction heads before and after the rise were proportional to the squares of the respective velocities at the Bridge Sections. The two cross sections used are: The upper one, located nearly opposite the Southwest Pier Gauge, and the lower one, at the International Bridge. Under original conditions, the areas of the upper and lower cross sections were 46260 and 13690 square feet, respectively, and the widths were 3400 and 2383 feet, respectively, at 601·86 feet, the mean river stage at Southwest Pier Gauge. According to formula 10, the discharge of the river at this stage was 82280 cubic feet per second. The corresponding mean water surface at the Bridge Section was 600·56 feet. Substituting these values in the preceding formula gives: Friction head before rise = 1·30 + 0.049 − 0·562 = 0·787 foot. Actual measurements taken under the conditions existing for the fifth and tenth periods show that a rise of 1 foot at Southwest Pier Gauge for mean river stage caused a rise of 0·636 and 0·592 foot at the bridge, respectively. These are the values for

rise before and after compensating works had been constructed. The mean of the above values (0·614 foot) has been used as the assumed rise under conditions, since the relation appeared to be nearly constant for two radically different discharge periods. After a rise of 1 foot at the upstream section, the mean velocity became $\frac{D}{49660}$ feet per second, and the corresponding velocity head was $\frac{\left(\frac{D}{49660}\right)^2}{2g}$. For the rise of 0·614 feet at the downstream section, the mean velocity became $\frac{D}{15150}$ feet per second, and the corresponding velocity head was $\frac{\left(\frac{D}{15150}\right)^2}{2g}$. The potential head after rise was: $F = 1\cdot30 + 1\cdot00 - 0\cdot614 = 1\cdot686$ feet. Substituting the new values in Bernouilli's formula gives: Friction head after rise $= 1\cdot686 + \frac{\left(\frac{D}{49660}\right)^2}{2g} - \frac{\left(\frac{D}{15150}\right)^2}{2g}$. Under the previous assumption that the friction heads before and after the rise were proportional to the square velocities we have:

$$0.787 : 1.686 + \frac{\left(\frac{D}{49660}\right)^2}{2g} - \frac{\left(\frac{D}{15150}\right)^2}{2g} :: 6\cdot01^2 : \left(\frac{D}{15150}\right)^2 \qquad (12)$$

Whence D = 103840 cubic feet per second. This value represents the discharge through the main channel at 1 foot above mean river stage, 601·86. The difference between this discharge value and 82280, the discharge for mean stage, is 21560 cubic feet per second, the increment of discharge for 1 foot rise above mean stage. This method was also used for the determination of the increment for one foot below mean stage, which gave 20720. The mean of 21560 and 20720, viz., 21140 cubic feet per second, has been used as the increment of discharge.

34. The discharge formula governing the flow through the main channel for the first period is as follows:

$$D_{1\ \text{MAIN CHANNEL}} = 21140\ (\text{Southwest Pier Gauge} - 601\cdot86) + 82280. \qquad (13)$$

35. The two small streams (*a* and *b*) situated on the north side of the main channel had a flow of 1800 cubic feet per second at mean river stage, with an estimated increment of discharge per foot rise of 950 cubic feet per second. The third small stream (*c*) situated also on the north side of the main channel had an estimated flow of 1800 cubic feet per second at mean river stage, with an estimated increment of discharge per foot rise of 950 cubic feet per second. By combining the above results, the discharge formula of the St. Marys River for the original conditions, or first period (January, 1860, to November, 1888, inclusive) before any alterations had occurred in the outlet to Lake Superior above the St. Marys Rapids, is:

$$D_1 = 23040\ (\text{Southwest Pier Gauge} - 601\cdot86) + 85880. \qquad (14)$$

36. The construction of any engineering structure necessarily takes time; so, in the building of the piers and approaches for the International Bridge, some time elapsed before the completion of the substructure. It is assumed that original conditions prevailed to December 1, 1888, after which the piers and approaches for the International Bridge are considered as having been completed, and stream *c*, adjacent to the north shore, as having been closed. This date marks the beginning of the second period, which is assumed to continue to December, 1892, inclusive. The discharge formula governing the flow

through the main channel for this efflux condition has been computed in the same way as that for the first period. It is:

$D_{2\text{MAIN CHANNEL}} = 19080$ (Southwest Pier Gauge — 601·86) +77200. (15)

37. Two small streams (*a* and *b*) situated on the north side of the main channel were still flowing, as in the first period. Combining the results of the flow through the main channel and streams *a* and *b* gives the total flow in the St. Marys River for the second period as:

$D_2 = 20030$ (Southwest Pier Gauge — 601·86) + 79000. (16)

38. For the third period, January, 1893, to November, 1895, inclusive, the efflux condition was the same as that for February and March, 1896, when the discharge measurements were taken. It is assumed that the Chandler-Dunbar Water Power Company closed spans 1 and 2, on the American end of the International Bridge, at the beginning of this period. The volume of water used by them was estimated to be about 1065 cubic feet per second. Streams *a* and *b* were still flowing. The equation of discharge for St Marys River for the third efflux condition is:

$D_3 = 18826$ (Southwest Pier Gauge − 600) + 37060. (17)

39. In December, 1895, the beginning of the fourth period, the Lake Superior Power Company began using water on a large scale, estimated by the chief engineer of the Lake Superior Power Company at 3800 cubic feet per second. The Chandler-Dunbar Water Power Company is assumed to have been still using 1065 cubic feet per second. Streams *a* and *b* were still flowing. The discharge equation for the fourth period, from December, 1895, to January, 1896, inclusive, is:

$D_4 = 18826$ (Southwest Pier Gauge − 600) + 40860. (18)

40. The fifth epoch, February and March, 1896, marks the date of the first discharge measurements of the St Marys River used in this report. The discharge formula for the river flow is:

$D_5 = 18826$ (Southwest Pier Gauge − 600) + 37060. (19)

41. For the sixth period, April, 1896, to December, 1897, inclusive, the auxiliary flow is estimated at 3500 cubic feet per second through the works of the Lake Superior Power Company. Streams *a* and *b* were still open. The Chandler-Dunbar Water Power Company was using approximately 1065 cubic feet per second. The three latter are included in the river discharge formula as derived form observations made in February and March, 1896. The discharge equation of the St Marys River for this period is:

$D_6 = 18826$ (Southwest Pier Gauge − 600) + 40560. (20)

42. For the seventh period, January, 1898, to March, 1899, inclusive, 4000 cubic feet per second is estimated as the side flow through the works of the Lake Superior Power Company. Streams *a* and *b* were still flowing. The Chandler-Dunbar Water Power Company is estimated to have been still using about 1065 cubic feet per second. The discharge through the locks for this period and previous thereto has not been incorporated in the discharge equations owing to the fact that it is considered to have been, comparatively, a small quantity. The discharge equation giving the flow of the St Marys River for this period is:

$D_7 = 18826$ (Southwest Pier Gauge − 600) + 41060. (21)

43. For the eighth period, April, 1899, to December, 1899, inclusive, the side flow through the works of the Lake Superior Power Company is estimated at 4000 cubic feet per second. Streams *a* and *b* were still flowing. The Chandler-Dunbar Water Power Company is assumed to have increased its flow at the beginning of the period from 1065 cubic feet per second to 1400 cubic feet per second. It is estimated that the American and Canadian locks were using at that time an average flow of 600 cubic feet per second. By combining the

above data, the net side flow, other than that at the time of the 1896 discharge measurements, = 4000 + (1400 − 1065) + 600 = 4935 cubic feet per second (4940 used). The discharge formula for the St Marys River for this period is:

D_8 = 18826 (Southwest Pier Gauge − 600) + 4200. (22)

44. For the ninth period, January, 1900, to September, 1901, inclusive, streams *a* and *b* are assumed to have been closed at the beginning of the epoch. The shutting of these two channels decreased the increment of discharge per foot rise by 950 cubic feet per second, or to 17880, but did not change the total discharge for the main channel at stage 600 on account of the discharge of streams *a* and *b* being approximately zero at this stage. The side flow through the works of the Lake Superior Power Company is estimated to have been 5000 cubic feet per second. The Chandler-Dunbar Water Power Company and the American Canadian locks are assumed to have been using 1400 and 600 cubic feet per second respectively. By combining the above data, the net side flow of the river, other than that at the time of the 1896 measurements, was: 5000 + (1400 − 1065) + 600 = 5935 cubic feet per second, (5940 used). The discharge formula for the St. Mary's River for this period is:

D_9 = 17880 (Southwest Pier Gauge − 600) + 43000. (23)

45. For the tenth period, October, 1901, to December, 1904, inclusive, the discharge formula derived from the measurements taken at the International Bridge in 1902, after the compensating works had been constructed by the Michigan Lake Superior Power Company, is:

$D_{10\ \text{MAIN CHANNEL}}$ = 15540 (Southwest Pier Gauge − 600) + 30510. (24)

46. This equation represents the flow through the St. Marys Rapids and does not take into account the flow through the Chandler-Dunbar Water power Company's forebay and plant. Previous to this period, the quantity of water used by the Chandler-Dunbar Water Power Company is considered directly in the discharge equation. The side flow through the works of the Lake Superior Power Company is estimated to have been 5000 cubic feet per second. The Chandler-Dunbar Water Power Company and the American and Canadian locks are estimated to have been using about 1400 cubic feet per second, and 600 cubic feet per second, respectively. The discharge formula of the St. Marys River, used for the efflux condition, is:

D_{10} = 15540 (Southwest Pier·Gauge − 600) + 37510. (25)

47. For the eleventh period, January, 1905, to December, 1907, inclusive, the discharge formula depends on discharge measurements made by the United States Lake Survey in February and March, 1905, at "Section Brewery," located about 2000 feet below Spry's Dock Section, which was situated opposite the power house belonging to the Michigan Lake Superior Power Company. During this period, the side flow through the works of the Lake Superior Power Company, the Michigan Lake Superior Power Company, the Chandler-Dunbar Water Power Company, and the American and Canadian locks is estimated at 6000, 8500, 1,400, and 600 cubic feet per second respectively. The discharge formula giving the total flow of the river for this period, based on the 1905 measurements, is:

D_{11} = 18484 (Southwest Pier Gauge − 600) + 41830. (26)

48. It has been noted that the discharge formulæ for efflux periods 10 and 11 show a difference in the increment of discharge of 2944 cubic feet per second for substantially the same conditions, the only known change in the regimen being an assumed constant diversion of 8500 cubic feet per second through the canal of the Michigan Lake Superior Power Company. This difference in increment is probably due in part to greater leakage at high stage through the dam of the Chandler-Dunbar Water Power Company.

49. The following table gives a summary of the discharge equations for the St. Marys River for the several efflux periods:

TABLE 18.

Summary of St. Marys River Discharge Equations for the Different Efflux Conditions.

No. of Period.	Length of Period.	Discharge Equation, St. Marys River.
1	Jan. 1860—Nov. 1888	$D^1 = 23040$ (Southwest Pier gauge—601·86)+85880
2	Dec. 1888—Dec. 1892	$D^2 = 20030$ (Southwest Pier gauge—601·86)+79000
3	Jan. 1893—Nov. 1895	$D^3 = 18826$ (Southwest Pier gauge—600·00)+37060
4	Dec. 1895—Jan. 1896	$D^4 = 18826$ (Southwest Pier gauge—600·00)+40860
5	Feb. 1896—Mar. 1896	$D^5 = 18826$ (Southwest Pier gauge—600·00)+37060
6	Apr. 1896—Dec. 1897	$D^6 = 18826$ (Southwest Pier gauge—600·00)+40560
7	Jan. 1898—Mar. 1889	$D^7 = 18826$ (Southwest Pier gauge—600·00)+41060
8	Apr. 1899—Dec. 1899	$D^8 = 18826$ (Southwest Pier gauge—600·00)+42000
9	Jan. 1900—Sep. 1901	$D^9 = 17880$ (Southwest Pier gauge—600·00)+43000
10	Oct. 1901—Dec. 1904	$D^{10} = 15540$ (Southwest Pier gauge—600·00)+37510
11	Jan. 1905—Dec. 1907	$D^{11} = 18484$ (Southwest Pier gauge—600·00)+41830

Southwest Pier Gauge gives the elevation of the water surface of St. Marys River at Southwest Pier, above the locks, Sault Ste. Marie, Mich., above mean tide at New York.

50. The monthly mean discharge values of the St. Marys River, from January, 1860, to December, 1907, inclusive, are given in Table 19.

51. PROBABLE EFFECT UPON MEAN LEVEL OF LAKE SUPERIOR OF OBSTRUCTIONS IN ST. MARYS RIVER AT HEAD OF RAPIDS. Any obstruction placed in the river at or near its critical or controlling discharge section changes the volume of flow and effects the level of the lake above and also the levels of those below. The construction of the piers and approaches of the International Bridge changed the discharge of the river and raised the mean level of Lake Superior. The shutting off of spans 1 and 2 on the American side, from the main channel, by the Chandler-Dunbar Water Power Company, and the construction of the compensating works by the Michigan Lake Superior Power Company have also had their effect on the level of Lake Superior and the Lower lakes. The ultimate effect of these obstructions placed in the main channel has been derived for mean river stage on the assumption that no diversions have been made by the Lake Superior Power Company or the Michigan Lake Superior Power Company. This maximum effect on lake levels has not entirely taken place, owing to these diversions by the said power companies. In treating this subject, use has been made of the incomplete-weir formula, river-discharge increments and river-gauge relations. The discharge through the main channel of the St. Marys Rapids for the third to ninth periods, inclusive, for mean river stage at Southwest Pier Gauge, (1871 to 1905, inclusive,) 601·86, has been previously computed as 69200 cubic feet per second. The corresponding measured mean water surface at the International Bridge Section during the period of flow was 600·61. In 1902 after the compensating works of the Michigan Lake Superior Power Company were built, practically closing spans 9 and 10, the mean water surface of this section was measured as 600.98 for the same discharge, 69200 cubic feet per second. The rise of 0·37 foot in the water surface represents the swell, h_s, at the International Bridge Section, due to the shutting off by the compensating works of the two spans on the Canadian side of the rapids. These actual measurements afford a means for determining an experimental value of u in the incomplete-weir formula:

$$D = u\ b\ \sqrt{2g}\left\{\frac{2}{3}\left((b_s + K)^{\frac{3}{2}} - k^{\frac{3}{2}}\right) + d\ (h_s + k)^{\frac{1}{2}}\right\}. \quad (27)$$

whereD = 69200 cubic feet per second, the discharge through the St. Marys Rapids, in third to ninth periods, inclusive, with mean water surface at International Bridge of 600·61, and in tenth period with mean water surface of 600·98,
b_A = 1511 feet, width of channel after obstruction by compensating works,
2g = 64·4 feet per second per second,
h_s = height of swell, in feet.
$k = \frac{V^2}{2g} = \frac{(D/A_B)^2}{2g}$ = 0·655 foot = theoretical velocity head previous to placing of obstruction, and where A_B is area of cross section of main channel before compensating works were built = 10650 square feet.
$d = \frac{A_B}{b_B} = \frac{10650}{1794}$ = 5·937 feet mean depth previous to construction of works, where b_B is width of channel in third to ninth periods, inclusive. Substituting these values in the above equation and solving gives a value for u of 0·899. The building of the piers and approaches of the International Bridge, according to computations, reduced the discharge through the main channel from 82280 to 77200 cubic feet per second, decreased the channel width from 2383 to 2232 feet, and changed the cross-sectional area from 13690 to 12490 square feet. Substituting these values in the incomplete-wier formula and using the experimenta, value of u (0·90) gives the swell, h_s, at the bridge site, due to the construction of the piers and approaches, as 0·183 foot. The corresponding rise at Southwest Pier was 0·298 foot. This latter value represents the estimated rise in mean lake level caused by the building of the International Bridge. About four years after the International Bridge was built, the Chandler-Dunbar Water Power Company shut off spans 1 and 2, on the American side, from the main channel. This obstruction reduced still more the mean discharge through the main channel. Using the incomplete-weir formula,

$$D = ub\ \sqrt{2g}\left\{\frac{2}{3}\left((h_s + k)^{\frac{3}{2}} - k^{\frac{3}{2}}\right) + d(h_s + k^{\frac{1}{2}}\right\}$$

for determining the effect of building the bridge piers and approaches and closing spans 1 and 2, where D = 82280 cubic feet per second, discharge at mean river level, under original conditions,
u = 0·90, experimental coefficient for present case,
b_A = 1794 feet, width of channel after obstructions were built,
2g = 64·4 feet per second,
$k = \frac{V^2}{2g} = \frac{(D/A_B)^2}{2g}$ = 0·562 feet, theoretical velocity head previous to placing of obstructions, where A_B is area of cross section of main channel before structures were placed = 13690 square feet.
$d = \frac{A_B}{b_B}$ = 5·745 feet = mean depth before structures were placed, where b_B = 2383 feet.

and solving for h_s gives 0·496 foot as the swell at the Bridge Section due to the construction of these works. The discharge formula for the flow through the main channel of the rapids, after the bridge piers and approaches were built and spans 1 and 2 were closed, according to 1896 measurements, is: $D_{\text{RAPIDS } 3-9}$ = 17880 (Southwest Pier Gauge—600·00) + 35995, while that after the compensating works were built, according to the 1902 measurements, is: $D_{\text{RAPIDS } 10}$ = 15540 (Southwest Pier Gauge—600·00) + 30510. The increment at Southwest Pier Gauge, as determined in 1896 and 1902, is 17880 and 15540, respectfully, while that at the Bridge Section for the 1896 conditions was unknown, and for 1902 was 22600. In order to determine the increment at the bridge, under the 1896 conditions, the assumption has been made that the increments of discharge per foot rise under the same efflux conditions are directly proportional for various points in a stream. This proportion is; Increment Southwest Pier$_{10}$: increment Southwest Pier$_{3-9}$ :: increment Bridge$_{10}$: increment Bridge$_{3-9}$ or, inserting values, 15540 : 17880 :: 22600 : X. Solving: X = 26000. The difference between the discharge through the main channel in the rapids for the first period and the third-ninth period is 82280—69200 = 13080 cubic feet per second. This quantity represents the volume of water cut off by the construction of the bridge piers and approaches and closing of spans 1 and 2. Since 1 foot rise at the bridge, under original conditions, is equivalent to an increase in discharge of 26000, then the swell caused by these obstructions involving a reduction in discharge of 13080 cubic feet per second is $\frac{13080}{26000} = 0\cdot503$ foot. The swell at the bridge, due to the building of the piers and approaches for the International Bridge, the shutting off of spans 1 and 2 by the Chandler-Dunbar Water Power Company, and the closing of spans 9 and 10 by the construction of the compensating works, computed by the incomplete-weir formula, is 0·817 foot. Substracting 0·37 foot, the actual measured swell due to the building of the compensating works, gives 0.447 foot as the swell at the Bridge Section due to the building of the piers and approaches of the international Bridge and the shutting off of spans 1 and 2.

52. Summarizing: The swell at the Bridge Section, due to the construction of the piers and approaches and shutting off of spans 1 and 2, is:

Incomplete weir, (direct)	0·496 foot
Increment	·503 foot
Incomplete weir, (indirect) 0·817—0·370	·447 foot
Mean swell	·482 foot

53. The above value represents the swell at the bridge due to these obstructions, but it does not represent the true effect on the St. Marys River at Southwest Pier. Since the increment of discharge at southwest Pier is 17880, the swell at that point due to decreasing the discharge through the rapids by 13080, is $\frac{13080}{26000} = 0\cdot732$ foot. By water-surface relations between Southwest Pier and mean water surface at Bridge, it is found that for mean river stage (601·86) at Southwest Pier, the corresponding mean water surface at Bridge is 600·613. Adding 0·482 foot, the mean swell at the bridge due to the construction of the piers and approaches and shutting off of spans 1 and 2, gives 601·095 as the new mean water surface. The gauge readings at Southwest Pier, corresponding to this mean surface at the bridge, is 602·645. The difference between 602·645 and 601·86 is 0·785, the swell due to building these obstructions.

54. Summarizing: The swell at Southwest Pier, due to building the piers and approaches for the International Bridge and shutting off of spans 1 and 2, is:

Increment method	0·732 foot
Gauge relations	·785 foot
Mean	·758 foot

55. During the period immediately following the building of the compensating works, the mean water surface at the Bridge Section was 600·54 for mean river stage. The rapids' discharge, corresponding to this gauge height, was 59300

cubic feet per second. The difference between the mean rapid's discharge before and after the building of these works is computed to be 69200—59300 = 9900 cubic feet per second. The increment of discharge at the bridge, as determined by measurement, was 22600. From these data, the swell at the bridge is computed to be $\frac{9900}{22600}$ = 0·439 foot. Actual measurements taken before and after the compensating works were built give the swell at the bridge as 0·37 foot.

56. Summarizing: The swell at the bridge Section, due to the construction of the compensating works, is:

Increment (direct)	0·439 foot
Actual measurement	·370 foot
Incomplete weir (indirect, 0·817—0·482)	·335 foot
Mean	·381 foot

57. The swell at the southwest pier for this period, computed by the increment method, is $\frac{9900}{15540}$ = 0·638 foot, while by gauge relations it was 0·648 foot. The mean of these two values gives 0·643 foot as the rise in the mean river stages at the southwest pier due to the compensating works.

58. SUMMARY. The mean stage of St. Marys River at the southwest pier, from 1871 to 1905, inclusive, is 601·86. The effect of the building of the piers and approaches to the International Bridge and the shutting off of spans 1 and 2 on the American shore by the Chandler-Dunbar Water Power Company was to raise the mean river level at the southwest pier 0·758 foot, or to an elevation of 602·618. The effect of the construction of the compensating works on the mean river level at Southwest Pier was to raise it 0·643 foot, or to a new mean river stage of 603·261. The mean water surface at the International Bridge, after the compensating works were built, corresponding to 603·261 at Southwest Pier, was 601·423 feet. Substracting from this value the swell at the bridge, due to the compensating works, namely, 0·381 foot, gives the mean water surface at the bridge, before the compensating works were built, as 601·042. Substracting from this new value 0·482 foot, the swell at the Bridge Section due to the construction of the piers and approaches to the International Bridge, and the shutting off of spans 1 and 2 from the main channel, gives 600·56 as the original mean water surface at the Bridge Section. The effect of placing obstructions in the St. Marys River at or near the International Bridge site has been to raise the mean level of the river at the bridge and Southwest Pier, and also the mean level of Lake Superior. If no diversions from the upper river had occurred the ultimate rise in the mean level of the St. Marys River and Lake Superior would have been approximately 1·40 feet; but, owing to diversions having taken place, this rise has been diminished.

ST. CLAIR RIVER DISCHARGE.

59. During the period from April, 1899, to September, 1902, inclusive, the United States Lake Survey measured the discharge of the St. Clair River, the outlet to Lake Huron, in the vicinity of Port Huron, Mich. These measurements have been used in deriving a formula for the flow of this river in terms of G.T.R. and Dry Dock gauge heights. The elevation of the crest of the submerged

weir has been assumed at 543 feet above mean sea level. The St. Clair River discharge formula, as derived is:

$$D = \left(\frac{C_{\text{G.T.R.}} + C_{\text{D.D.}}}{2}\right) F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right) \qquad (28)$$

in which the coefficients depending on the stage at G.T.R. and Dry Dock, derived from the discharge measurements, are:

$$C_{\text{G.T.R.}} = \frac{2700 \cdot 316}{\frac{62 \cdot 872}{h_U} - 1}, \text{ and } C_{\text{D.D.}} = \frac{2766 \cdot 21}{\frac{61 \cdot 982}{h_D} - 1}, \text{ respectively.}$$

60. This discharge equation of the St. Clair River, depending on the gauge readings at G. T. R. and Dry Dock, has been transformed to one depending on G. T. R. and St. Clair Flats, on account of the long series of readings taken at the St. Clair Flats Canal. In order to substitute the St. Clair Flats Canal readings for Dry Dock readings in the discharge formula, the following equation was used: (Fall, G. T. R. to St. Clair Flats Canal) = 7·4482 (Fall, G. T. R. to Dry Dock) = 1·9657. The St. Clair River discharge formula, as transformed, is:

$$D = \frac{C_{\text{G.T.R.}} + C_{\text{ST. CLAIR FLATS CANAL}}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right). \qquad (29)$$

The coefficients drived in this transformed equation are:

$$C_{\text{G.T.R.}} = \frac{1308 \cdot 339}{\frac{64 \cdot 674}{h_U} - 1}, \text{ and } C_{\text{ST. CLAIR FLATS CANAL}} = \frac{1445 \cdot 118}{\frac{59 \cdot 123}{h_D} - 1}$$

61. This last equation, expressed in terms of St. Clair Flats and G.T.R., has been used to compute the mean discharges of St. Clair River from 1860 to 1907, inclusive.

62. In 1900, the Chicago Drainage Canal began diverting water from Lake Michigan. The quantity used from 1900 to June, 1904, inclusive has been computed from data furnished the Commission by the United States Engineer Office at Chicago. The flow through the canal for the last half of the year 1904, and 1905, 1906, and 1907, has been assumed to be the quantity authorized in the permit of the Secretary of War.

DETROIT RIVER DISCHARGE.

63. The Detroit River discharge equation has been derived from measurements taken at Fort Wayne, Mich., by the United States Lake Survey during the summers of 1901 and 1902. The elevation of the crest of the weir is assumed as 540 feet above mean sea level. A part of these observations were rejected owing to the fluctuation in the level of water at Amherstburg during the discharge measurement. The remaining discharges were used in determining the discharge equation. The discharge formula, as derived, is:

$$D_{\text{DETROIT}} = \frac{C_{\text{W. PT.}} + C_{\text{AM H.}}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right). \qquad (30)$$

in which $C_{\text{W. PT.}}$ for the upstream head at Windmill Point

$$= \frac{11 \cdot 745}{\frac{52 \cdot 248}{h_U} - 1},$$

$C_{AMH.}$ for the downstream head at Amherstburg $= \dfrac{20\cdot529}{\dfrac{60\cdot083}{h_D} - 1}$,

F = fall, Windmill Point to Amherstburg,
h_U = upstream head on crest of submerged weir, determined by Windmill Point gauge heights,
h_D = downstream head on crest of submerged weir, determined by Amherstburg gauge heights.

64. Owing to the lack of sufficient observations, no winter discharge formulæ have been derived for the Detroit or St. Clair Rivers. It is, undoubtedly, true that for the same slope the discharge is less with an ice covering than without one, on account of the increased friction.

Ice gorges occur in the St. Clair and Detroit rivers nearly every winter, creating an abnormal slope in the river that is gorged. Under such conditions, the discharge value, computed from the river not gorged, has been used as the correct monthly mean inflow to Lake Erie.

65. The monthly mean discharge values of the Detroit River from January, 1860, to December, 1907, inclusive, are given in Table 20.

NIAGARA RIVER DISCHARGE.

66. The discharge of the Niagara River has been determined by measurements taken at the International Bridge, located at Buffalo, N.Y., and at a point about 1800 feet down, stream at the "Open Section." These observations were begun in 1897 under the direction of E. E. Haskell, Engineer for the United States Deep Waterways Commission. At the conclusion of this work, the United States Lake Survey continued the measurements in 1898, 1899, and 1900. These measurements have been reduced on the assumption that the outlet of Lake Erie is a submerged weir with a broad, flat, crest, whose upper nappe is about one mile in length and the lower one about two, with the crest section at or near the Buffalo Waterworks' Intake Pier. The Niagara River discharge formula, as derived, is

$$D_{NIAGARA} = CbF^{\frac{1}{2}}\left(h_U + \frac{h_D}{2}\right). \qquad (31)$$

in which F = fall from Buffalo Breakwater Light-house, in Lake Erie, to Austin Street, in Niagara River,
h_U = upstream head on crest of submerged weir, determined by Buffalo Breakwater Light-house gauge,
h_D = downstream head on crest of submerged weir, determined by Austin Street gauge,
$C = -0\cdot02458h_U + 2.550$,
556·35 = the average elevation of the crest of the weir above mean tide at New York,
b = width of crest section, at Waterworks' Intake, which is determined as follows: Compute the mean fall in the Niagara River from Buffalo Breakwater Light-house to Austin according to the formula, $F = 0\cdot02976X^2 - 0\cdot4896X + 6\cdot5828$, in which X = Lake Erie stage at Buffalo Breakwater Light-house gauge above elevation 560 feet. Substitute this value for fall, or the actual fall between these two points in the equation, (Fall, Buffalo Breakwater Light-house to Waterworks' Intake = 0·4916 (Fall, Buffalo Break-water Light-house to Austin Street) + 0·6553, and solve for fall from Buffalo Breakwater Light-house to Waterworks' Intake Section. Determine the corresponding stage of water at Waterworks' Intake Section by subtracting the fall from Buffalo Breakwater Light-house to

Waterworks' Intake Section from Lake Erie stage as measured at Buffalo Breakwater Light-house. Then substitute in the equation, b = 80 (Waterworks' Intake stage above mean tide at New York) − 43598, and solve for the width of the crest section.

The monthly mean discharge values of the Niagara River, from January, 1860, to December, 1907, inclusive, are given in Table 21.

ST. LAWRENCE RIVER DISCHARGE.

67. The St. Lawrence River discharge formula has been determined from discharge measurements made by the United States Lake Survey in 1901 and 1902 at 'Three Points Section,' situated about 15 miles below Ogdensburg, N.Y., and 9 miles below the head of the Galop Rapids. During the measurements, no simultaneous gauge readings were observed at Lock 27. Since the discharge equation is expressed in terms of Ogdensburg and Lock 27 gauge heights, the latter have been computed for each measurement according to the equation, (Ogdensburg —240) = 0·0006489 (Lock 27—240)2 + 0·97085 (Lock 27—240) + 1·3502, which was derived from simultaneous monthly mean readings taken at the two places. This method was deemed most accurate, for, during the months when observations were taken, the slope between Ogdensburg and Lock 27 approximated very closely the mean slope computed by the above formula. It has been assumed that the submerged weir lies between Ogdensburg and Lock 27, near the head of the Galop Rapids, and the mean elevation of the crest of this weir is 230 feet above mean sea level at New York. The discharge equation, as deduced for summer flow, May to November, inclusive, before the Gut channel at the Galop Rapids was closed, is:

$$D_1 \text{ (SUMMER) ST. LAWRENCE} = \frac{C_{OG} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right). \quad (32)$$

In which C_{OG}., for the upstream head measured at Ogdensburg self-registering

$$\text{gauge, is} = \frac{114430 \cdot 485}{\frac{152 \cdot 389}{h_U} + 1}$$

$$C_{27}, \text{ for the downstream head, measured at Lock 27, is } = \frac{54597 \cdot 508,}{\frac{59 \cdot 445}{h_D} + 1}$$

F = fall, Ogdensburg to Lock 27,

h_U = upstream head on crest (elevation 230) of submerged weir, determined by Ogdensburg gauge height,

h_D = downstream head on crest (elevation 230) of submerged weir, determined by Lock 27 gauge height.

68. The slope in the river, from Oswego and Ogdensburg to Lock 27, increases in the winter, due to the ice covering, which causes increased friction with the water and decreases the discharge for a given stage. The average increase in fall for the winter season, between 27 and Ogdensburg, has been determined as 0·31 foot. For any given stage at Lock 27, with mean summer slope to Ogdensburg, the discharge of the St. Lawrence River can be derived by formula (32). With this known river discharge and stage at Lock 27, and with Ogdensburg gauge heights increased by 0·31 foot for average winter con-

ditions, a solution for C in the submerged-weir formula has been made. This operation was repeated so as to cover the range in stage at these two gages.

69. The winter discharge equation, as deduced, covering the period from December to April, inclusive, and before the Gut channel at the Galop Rapids was closed, is:

$$D_1 \text{ (WINTER) ST. LAWRENCE} = \frac{C_{OG} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right), \quad (33)$$

in which *Crc.*, for the upstream head, measured at Ogdensburg self-registering gauge in the winter season, is $= \dfrac{131202 \cdot 913,}{\dfrac{206 \cdot 737}{h_D} + 1}$

C_{27}, for the downstream head, measured at Lock 27 in the winter season, is $= \dfrac{53597 \cdot 993,}{\dfrac{67 \cdot 401}{h_D} + 1}$

F = fall, Ogdensburg to Lock 27,
h_U = upstream head on crest (elevation 230) of submerged weir, determined by Ogdensburg gauge heights,
h_D = downstream head on crest (elevation 230) of submerged weir, determined by Lock 27 gauge heights.

70. As previously stated, the winter months have been considered as December to April, inclusive. During many of these months, ice gorges have occurred in the river, above the Galop Rapids, which conditions have invalidated the winter-slope relation and caused abnormally high discharge values. Fortunately, below the Galop there are two more submerged weirs, one at the head of Rapide Plat, near Lock 24 on the Morrisburg Canal, and the other at the head of the Long Sault Rapids, near Lock 21 on the Cornwall Canal, at which points water-level observation have been made by the Canadian Government for many years.

71. Owing to lack of data, the Commission has been unable to derive a submerged-weir formula for the St. Lawrence River discharge based on the stage of water at the Rapide Plat and Long Sault Rapids, and has used the overfall-weir formula derived by the United States Lake Survey for these two locations, and has also used in a few instances the overfall-weir formula in terms of Lock 27, when ice gorges occurred at Lock 24 and Lock 21 and the slope in the river above the Galop was abnormal.

72. These discharge equations for the St. Lawrence River flow are:

$$D_{27 \text{ ST. LAWRENCE}} = 5732\ (2 \cdot 80 + h_{27})^{\frac{3}{2}}\ , \quad (34)$$

$$D_{24 \text{ ST. LAWRENCE}} = 16.60\ (22 \cdot 10 + h_{24})^{2.8}, \quad (35)$$

$$D_{21 \text{ ST. LAWRENCE}} = 316 \cdot 0\ (83 \cdot 0 + h_{21})^{2.3} \quad (36)$$

where h_{27}. h_{24}, and h_{21} are the gauge readings above the old lock sill of each lock or zero.

73. In determining the monthly mean discharge of the St. Lawrence River for January, February, and March, form 1870 to 1907, inclusive, values have been deduced according to the submerged-weir and the three over-fall weir formulae. The minimum result in each case has been used as the most reliable value.

74. In 1903, the Canadian Government began work on closing the Gut channel, the smallest of the three channels at the head of the Galop Rapids.

The damming of this outlet decreased the discharge of the St. Lawrence River for any given stage. According to the United States Lake Survey, this change in flow has been about 5½ per cent less than that for the assumed original condition, January, 1860, to August, 1903, inclusive. This percentage change has been applied to the discharge equations for the period previous to September, 1903, and other discharge formulae deduced.

75. The formula as derived for summer conditions of flow of the St. Lawrence, after the Gut channel was closed, is:

$$D_{2\ (\text{SUMMER})\ \text{ST. LAWRENCE}} = \frac{C_{OG} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right) \qquad (37)$$

in which C for the upstream head, measured at Ogdensburg self-registering gage, is: $C_{OG} = \dfrac{1041120\cdot 68}{\dfrac{146\cdot 326}{h_U} + 1}$

C for the downstream head, measured at Lock 27, is: $C_{27} = \dfrac{55685\cdot 721}{\dfrac{650\cdot 75}{h_D} + 1}$

F = fall from Ogdensburg self-registering gauge to Lock 27,

h_U = upstream head on crest (elevation 230) of submerged weir, determined by Ogdensburg gauge heights,

h_D = downstream head on crest, determined by Lock 27 gauge heights.

76. The St. Lawrence River winter discharge formula, after the Gut channel was closed, as deduced, is:

$$D_{2\ (\text{WINTER})\ \text{ST. LAWRENCE}} = \frac{C_{OG} + C_{27}}{2} F^{\frac{1}{2}} \left(h_U + \frac{h_D}{2}\right), \qquad (38)$$

in which C for Ogdensburg self-registering gauge is: $C_{OG} = \dfrac{135093\cdot 09}{\dfrac{226\cdot 492}{h_U} + 1}$,

C for Lock 27 is: $C_{27} = \dfrac{52177\cdot 516.}{\dfrac{69\cdot 799}{h_D} + 1}$

The remaining factors are the same as for summer flow.

The monthly mean discharge values of the St. Lawrence River, from January, 1860, to December, 1907, inclusive, are given in Table 22.

DISCHARGE INCREMENTS OF THE RIVER OUTLETS OF THE GREAT LAKES SYSTEM.

77. The discharge increment, or rate of change of river flow per unit change in stage, varies in the several river outlets of the Great Lakes. It is not only different for each river but it also changes with the section and the stage. In general, the increment at mean stage increases with each river lower in this series. The Detroit River increment is greater than the St. Clair; likewise, the St. Lawrence River increment is greater than the Niagara. It also increases as each river is descended. On the Niagara River, the increment at Buffalo Light-house, Buffalo, for mean stage of Lake Erie, is 23400 cubic feet per second per foot, while at Grass Island, near the intake of the Niagara Falls Power

Company, at Niagara Falls, N.Y., the increment is about 43000 cubic feet per second per foot. There are exceptions to this rule when the river section is contracted. At the head of the Whirlpool Rapids, in the Niagara River, a contracted section reduces the increment to about 9000 cubic feet per second per foot. In the St. Lawrence River, contracted sections occur at the head of the Rapide Plat and the head of the Long Sault Rapids. At the former, the increment is about 22500 cubic feet per second per foot, while at Lake Ontario it is 28100 cubic feet per second per foot. Table 23 gives the discharge increments, expressed in cubic feet per second per foot change in stage, of the several river outlets of the Great Lakes.

INCREMENTS OF DISCHARGE OF THE SEVERAL RIVER OUTLETS OF THE GREAT LAKES, EXPRESSED IN CUBIC FEET PER SECOND PER FOOT CHANGE IN STAGE.

River.	Location of Gauge.	Stage.	Increment.
St. Marys	Sault Ste. Marie, Mich	601·91 (Mean)	18,500
		601–602	18,500
		602–603	18,500
St. Clair	Harbour Beach, Mich	581·44 (Mean)	18,900
		579—580	16,300
		580—581	17,500
		581—582	19,100
		582—583	20,900
Detroit	Windmill Point, Mich	575·40 (Mean)	20,600
		574—575	18,300
		575–576	20,900
		576—577	22,500
Niagara	Buffalo, N.Y	572·67 (Mean)	23,400
		570—571	19,600
		571–572	21,400
		572—573	23,200
		573—574	25,100
St. Lawrence	Ogdensburg, N.Y	245·28 (Mean)	28,100
		244—254	26,800
		245—246	27,600
		246—247	29,300
		247—248	29,800

SUPPLY FACTORS OF GREAT LAKES.

78. The total supply (S) of water to a reservoir or lake depends on the inflow (I) or transmitted supply from another watershed, the precipitation (P) on the surface of the lake, the run-off (R) from the lake's watershed, and evaporation (E) from the lake's surface; or the outflow or discharge (D) from and storage (S) in the lake. Of these factors, for the Great Lakes, the transmitted supply (I), the discharge (D), and the storage (S), are known singly, while the value of precipitation (P), run-off (R), and evaporation (E), is known collectively.

79. The following equation expresses the total supply to any lake:

$$S = I + R + P - E = D \mp s. \qquad (39)$$

Now, $s = Ah$, where A is the area of the lake and h the depth in feet above any datum. Transposing and substituting in (39) the value of s, we have:

$$S - D = Ah \qquad (40)$$

80. The following equation shows the rate of change in the depth (dh) at any instant of time (dt):

$$(S-D)\,dt=A\,dh \qquad (41)$$

Intergrating with respect to t and h between the limits o and t and o and h, respectively, we have:

$$(S-D)\int_{o}^{t}dt=A\int_{o}^{h}dh \qquad (42)$$

$$(S-D)t=Ah \qquad (43)$$

81. An inspection of equation (43) shows that when S is greater than D the lake surface is rising and the storage is increasing, when S is less than D the lake surface is falling and the storage is decreasing; and when S is equal to D the lake surface remains at the same level and there is no change in the storage.

82. The local supply (L) to a reservoir or lake has been assumed as the water-yield from its own watershed. It is also, in a series of connecting watersheds, equal to the total supply (S) minus the transmitted supply or inflow (I) from the watersheds situated above.

83. The following equation expresses the local supply to any lake

$$L=S-I=(D\mp s)-I=R+P-E \qquad (44)$$

84. The known supply factors have been deduced for Lakes Superior, Michigan-Huron, Erie, and Ontario for the period of 48 years, from 1860 to 1907, inclusive. These results are shown in Tables 24, 25, 26, and 27, and Plates 2-17, inclusive.

85. For Lake Superior, the water levels at Marquette, Mich., have been assumed to represent the mean lake surface, and those at Sault Ste. Marie, Mich., (above the locks) have been used in computing the discharge of the lake's outlet. The stage readings on the first of the month for this lake and those lower in the series have been interpolated from the monthly mean readings. For Lake Michigan-Huron, the mean of the stage values for Milwaukee, Wis., and Harbour Beach, Mich., has been used for the mean lake surface. Lake St. Clair has been treated as a part of the Michigan-Huron water-shed, and the Detroit River, as the natural lake outlet. Since 1900 water has been diverted from Lake Michigan through the Chicago Drainage Canal. The St. Clair River is the outlet to Lake Michigan-Huron, but, owing to the apparent changes in regimen prior to the first accurate discharge measurements in 1899, it became necessary to eliminate this river and use the Detroit, regardless of the fact that there have been many more discharge measurements of the St. Clair. The regimen of the Detroit River has, apparently, remained nearly constant during the period from 1860 to 1907, inclusive. For Lake Erie, the water levels at Cleveland, Ohio, have been used to represent the mean lake surface, and those at Buffalo, N.Y., to govern the outflow through the Niagara River. The volume of water diverted from the natural outlet of Lake Erie through the Erie and Welland canals has been estimated at 1000 and 1100 cubic feet per second, respectively. These amounts, added to the Niagara River discharge values represent the total outflow from Lake Erie. For Lake Ontario, the Oswego, N.Y., stage readings have been assumed to represent the mean water level of the lake. During periods in the spring, when the Oswego River was at flood stage, these water levels may be slightly in error. The outflow through the St. Lawrence River has been drived from the values of the Ogdensburg and Lock 27 gauge heights, used collectively, except as heretofore noted.

86. *Lake Superior Supply Factors.* An inspection of Plates 2-5, inclusive, shows that Lake Superior had a miximum monthly mean stage of 604·08, in September, 1869, and a minimum of 600·76, in February, 1871. During

the high water of 1876, Superior rose, in August, to 603·93. On several occasions, the lake level has fallen to about 601·0, or lower, as in 1879, 1880, 1892, and 1893. Since 1894, Superior has fluctuated between 601·46 and 603·54, a range of 2·08 feet, while the maximum fluctuation since 1860 has been 3·32 feet. The mean water level for the 48 years, 1860 to 1907, inclusive, was 602·32. The storage capacity of Superior is enormous, one foot depth on the lake surface being equivalent in volume to a constant inflow of 340,100 cubic feet per second for one month. During the period which this investigation covers, the storage has been over ×200000 cubic feet per second, for a month, on several occasions. In May, 1876, May, 1888, and May, 1899, Superior stored ×207500, ×212600, and ×204100 cubic feet per second, respectively. In August, 1869, the lake stage increased 0.655 foot, equivalent to ×222800 cubic feet per second storage. The occurrence of the maximum storage in the month of August is most unusual. At other times, the lake surface has fallen almost as rapidly. In November, 1869, November, 1870, December, 1870, December 1780 and December, 1897, the storage was—168400,—188800,—173400,—161600, and—137700 cubic feet per second, respectively. The corresponding feet depths on lake surface are: —0·495, —0·555, —0·510, —0·475, and —0·405. For the three months of November, and December, 1870, and January, 1871, Lake Superior fell from 602·47 on November 1st, to 601·06, on February 1st, a storage of —1·41 feet. The outflow from Lake Superior through the St. Marys River has not shown the fluctuations so noticeable in the storage. In September, 1869, the river discharged 128700 cubic feet per second, and in September, 1876, 121800 cubic feet per second. These two values represent the maximum monthly mean discharge to date. On only two ocacssion has the monthly mean discharge fallen below 50000 cubic feet per second, and that occurred during February and March, 1893, when it reached 48200 and 48400 cubic feet per second, respectively. The total monthly mean supply or water-field to Lake Superior has ranged between 333300 cubic feet per second, in August, 1869, and —106600, in December, 1870, equivalent to 0·980 and —0·313 foot depth on lake surface, respectively. A maximum monthly mean supply of ×200000 cubic feet per second, or more, has occurred in 21 of the 48 years. A minus monthly mean supply has occurred in 42 of the 48 years. Minus values have occurred in each month between October and April, inclusive, although December has been the prevailing one.

87. *Lake-Michigan Huron Supply Factors.* As shown on Plates 6-9, inclusive, the monthly mean stage of Lake Michigan-Huron has fluctuated between 583·58 and 583·60, in July, 1876, and June, 1886, respectively, and 579·00, in December, 1895, a range of 4·6 feet. Previous to 1886, the lake level had fallen to about 580·2 or 1·2 feet above the low water of 1895 and 1896, on only three occasions, March, 1869, March, 1872, and January and February, 1873. Since September, 1890, the monthly mean stage has not exceeded 581·5 except in July and August, 1905, and July, 1907, when it was 581·56, 581·54, and 581·56, respectively. The mean stage of Lake Michigan-Huron for the 48 years, 1860 to 1907, inclusive, was 581·38. As previously stated, in Table 1, the area of Lake Michigan-Huron is 45,314 square miles. An increase in depth of one foot on this surface is equivalent to a constant inflow of 480,700 cubic feet per second for one month. The storage on this lake, in May, 1873, and May, 1876, amounted to ×251400 and ×254800 cubic feet per second, respectively, with corresponding depths on surface of 0·523 and 0·530 foot. A monthly storage of ×150000 cubic feet per second is quite common. Occasionally, the high rate of storage extends over several months, as in April, May, and June, 1876, when the average monthly increase for this period had a value of ×220300, equivalent to a total change in stage of ×1·37 feet in three months. On the other hand, when the lake stage had fallen, as in August, September, October, November, and December, 1871, the average monthly decrease in

storage had a value of —183600 cubic feet per second, equivalent to a total decrease in stage of 1·91 feet in the five months. The minimum storage occurred in September, 1871, when it had a value of —261500 cubic feet per second, equivalent to a depth on lake of —0·544 foot. Values of —150000 to —200000 cubic feet per second have occurred frequently. The outflow through the Detroit River has ranged from about 275400, in July, 1883, to 105300, in February, 1874. The discharge of this river is dependent not only upon the stage of Lake St. Clair but also upon the fall to Lake Erie. The stage of Lake St. Clair is, in turn, dependent on the discharge from Michigan-Huron and on its outflow to Erie. A large discharge from Michigan-Huron raises Lake St. Clair quickly, while a high stage of Erie decreases the discharge of the Detroit River and raises Lake St. Clair by backwater. An increasing stage of Lake St. Clair with constant fall to Erie, or an increasing fall with the same St. Clair stage, gives increased discharge through the Detroit River.

88. Lakes Michigan-Huron and Erie do not rise and fall simultaneously. In some cases, the former will be rising and the latter falling. This is usually what occurs during the winter months of January, February, and March, and sometimes in December, April, and May. Ice gorges in the St. Clair or Detroit River hold back the water, thus depleting the supply to Erie and storing it in Michigan-Huron. When the gorge occurs in the St. Clair River, Lake St. Clair falls and the slope to Lake Erie becomes less than normal and that to Michigan-Huron greater. When the gorge occurs in the Detroit River, Lake St. Clair rises and the slope to Michigan-Huron is less than normal and that to Erie greater. If ice gorges of the same intensity should occur in the St. Clair and the Detroit rivers simultaneously, Lake St. Clair would probably not indicate the gorged condition, since the discharge increments of the two rivers would be decreased and the lake would remain at its normal level. By an inspection of the hydrograph of the Great Lakes, as shown on Plate 1, the effect of ice gorges in the St. Clair and Detroit rivers is seen. Attention is called particularly to the following months as indicating large gorges in the St. Clair River: February, 1865; March, 1877; January, 1884; February, 1886; April, 1901, and February, 1902. In each case, the stage of Lake St. Clair dropped and Michigan-Huron rose. Large ice gorges in the Detroit River occurred in January, 1870, December, 1876, December, 1880, January, 1889, and February, 1895. This fact is substantiated by the extreme rise in Lake St. Clair and by the fall in Lake Erie. The total monthly mean supply to Lake Michigan-Huron has fluctuated between ×470800 cubic feet per second, in June, 1883, and — 32000 cubic feet per second, in September, 1871, equivalent to a depth on the lake of ×0·979 and —0·067 foot, respectively. In May 1873, and May and June, 1876, the toatl supply exceeded ×450,000 cubic feet per second. In 10 of the 48 years, the monthly supply has been over ×400000 cubic feet per second. Monthly values of ×350000 cubic feet per second have occurred in over 60 per cent of the years. Other months show a total supply of less than 25000 cubic feet per second in many of these years. In April and May, 1873, May, 1876, and June, 1883, the local supply to Michigan-Huron was ×373000, ×365100, ×365400, and ×389100 cubic feet per second, respectively, corresponding to depth on lake of 0·776, 0·759, 0·741, and 0·809 foot, respectively. In September, 1871, the lake lost by evaporation 125700 cubic feet per second more than the actual precipitation on the lake surface and run-off of the tributary watershed. During the months from August to December, inclusive, a minus local supply has been common, in some cases extending over several months. From August to December, 1894, inclusive, evaporation on the lake surface exceeded the precipitation on the lake surface and run-off from the tributary watershed, and the stage of lake Michigan-Huron dropped 1·3 feet.

89. LAKE ERIE SUPPLY FACTORS. The monthly mean stage of Lake Erie (see Plates 10-13, inclusive) during the period covered in this report, has risen to 574·52, in June, 1876. The minimum stage occurred in February, 1902, when Erie fell to 570·63. During the latter month, an extensive ice gorge occurred in the St. Clair River, which explains the extreme low stage of Erie at the time. Prior to that time, the minimum stage of Erie occurred in November, 1895, when it fell to 570·70. The monthly mean level has fluctuated through an extreme range of 3·89 feet, while the annual mean oscillation in lake level has been 2·53 feet. The mean stage of Erie, from 1860 to 1907, inclusive, was 572·60. The amount of storage for a rise of one foot in the level of Lake Erie, is equivalent to a flow of 105700 cubic feet per second for one month. On but one occasion has the storage exceeded +100000 cubic feet per second. In April, 1873, it had a value of +103600, equivalent to a depth on lake surface of 0.98 foot. During the month of January, 1865, the storage reached a minimum of —52900 cubic feet per second, corresponding to—0·50 foot on lake surface. A value nearly as small as the latter occurred in November, 1903, when the storage had a value of —49700, equivalent to —0·47 foot. The maximum monthly mean discharge from Lake Erie, 257800 cubic feet per second, equivalent to a depth of 2·44 feet on Lake Erie, occurred in June, 1876. The minimum, 168700 cubic feet per second, equivalent to a depth of 1·60 feet on lake surface, occurred in March, 1896. Ice gorges in the Niagara River, apparently, have had comparatively little effect on the out-flow from Lake Erie. The maximum total supply of +314700 cubic feet per second to Erie, corresponding to a depth of +2·98 feet on lake, occurred in April, 1861. Large positive total supply values occurred in April, 1862, April, 1873, March and April, 1876 and June, 1883. The Values for the several months are: +307400, +309700, +295600, +289000, and +290300 cubic feet per second, respectively. In 16 out of the 48 years, a total monthly mean supply of +275000 cubic feet per second has been exceeded. During the five-month period from February to June, 1876, inclusive, Erie had a monthly mean total supply greater than +250000 cubic feet per second, and the stage increased 1·82 feet. At other times, the total supply has decreased to less than half the maximum. The minimum, + 146900 cubic feet per second, occurred in October, 1891, and November, 1903. The supply was nearly as low in January, 1865, and October, 1895, with values of +149300 and +148500 cubic feet per second, respectively. The total supply to Erie, apparently, has been much less than to the lakes above. In April, 1873, January and February, 1874, and May, 1892, it exceeded +100000 cubic feet per second by 10600, 3200, 21600, and 9200, respectively. Minus values occur very frequently. In many years, the last six months give a minus local supply. From June, 1884, to March, 1885, inclusive, a minus local supply occurred during the entire period with an average monthly value of —40400. During this period, the lake fell from 574·14, in June, to 571·92, in March, a change in stage of—2·22 feet. The minimum monthly local supply to Erie of —63600 cubic feet per second, corresponding to a depth on lake surface of—0·60 foot, occurred in December, 1871. From August to November 1867, inclusive, the monthly local supply was —57700, —60500, —61700, and —56500 cubic feet per second, respectively. Collectively, these values are equivalent to a depth on Lake Erie of 2·23 feet. During September, October and November, 1874, large successive local supply values of —50600, —56100, and —51200 cubic feet per second, respectively, occurred, equivalent to a total depth on Lake Erie of 1·49 feet. For September, October, and November, 1884, the monthly local supply was —53100, —57500, and —50600 cubic feet per second, respectively. These values are, collectively, equivalent to 1·52 feet depth on Lake Erie.

90. LAKE ONTARIO SUPPLY FACTORS. Referring to Plates 14-17, inclusive, the maximum stage of Lake Ontario occurred in May, 1870, when the lake

level had a value of 248·95. In 1861, 1862, 1863, 1864, 1867, 1876. 1883, 1884, 1886, 1887, and 1890, the stage exceeded 248·00. In November, 1895, the lake level dropped to 243·41, which has been the minimum stage during the 48 years from 1860 to 1907, inclusive. In two other years, the stage has fallen below 244·00. This condition occurred in January, November, and December, 1896 and January and February, 1897. This monthly fluctuation of Ontario is greater than that in any of the other Great Lakes. The maximum range in stage is 5·54 feet. Ontario fell from 248·48, in June, 1867, to 244·51, in January, 1868, a change in level of 3·97 feet. The mean stage of lake Ontario, for the period from 1860 to 1907, inclusive, was 246·19. A foot depth on Lake Ontario is equivalent to a monthly flow of 76800 cubic feet per second. During March and April, 1873, and March, 1904, the monthly storage equalled or exceeded one foot depth on the lake surface, with corresponding storage values of +79900, +96000, and +76800 cubic feet per second respectively. Twelve of the 48 years had a monthly storage of +50000 cubic feet per second or more. During October and November, 1867, the minus storage exceeded —50000 cubic feet per second, the values being —53800, and —57600 cubic feet per second, respectively. The discharge of the St. Lawrence River shows an extreme variation of about 130 per cent. This change in flow is small compared with rivers not having immense storage reservoirs at their sources. The maximum flow has been computed at 351200 and 350500 cubic feet per second, and occurred in May, 1862, and May, 1870, respectively. These values may be slightly too great on account of floods in the Oswego River causing abnormal gauge readings for lake stage. These maximum discharge values have been approached in June and July, 1870, when there was little likelihood of the stage being affected by these local floods. In these two months, the flow has been computed at 344100 and 343200 cubic feet per second, respectively. The minimum flow has approximated 155000 cubic feet per second. In February 1875, March, 1900, and February, 1902, the discharge was 157900, 156600, and 152200 cubic feet per second, respectively. These extreme low discharges have been caused by ice gorges in the river. The minimum outflow, not caused by ice gorges, occurred in December, 1895, and December 1896, when the discharge was 162500 and 164800 cubic feet per second, respectively. The total supply to Ontario has fluctuated between the maximum of + 382400 cubic feet per second, in April, 1870, and the minimum of +154100 cubic feet per second, in February, 1875, a range of 228300 cubic feet per second. The equivalent depths on lake surface are 4·98 and 2·01 feet, respectively. In May, 1861, and April, 1862, the total supply was + 377400 and + 375600 cubic feet per second, respectively. Values of 325000 cubic feet per second have occurred in 17 of the 48 years. Since May, 1893, the total monthly supply has exceeded + 300000 cubic feet per second in but two years, 1903 and 1904. In 10 of the 48 years, the yield, or total supply, varied between + 155000 and +175000 cubic feet per second during some months of the winter season. The Ontario local supply had a maximum of +151800 cubic feet per second, in April, 1870. In January, 1881, the minimum value of —34300 cubic feet per second occurred. In 7 years, the monthly mean local supply exceeded +125000 cubic feet per second. In 17 of the 48 years, it exceeded +100000 cubic feet per second. Minus values occurred frequently. The prevailing months for such values have been November, December, January, and February, although a minus local supply has occurred during all the months from August to February, inclusive.

MEAN MONTHLY SUPPLY FACTORS OF GREAT LAKES.

91. The mean monthly supply factors covering the period from 1860 to 1907, inclusive have been derived from the monthly mean supply values of the

several lakes for the 48-year period. Table 28 and Plate 18 give the results in numerical and graphical form. These curves show the mean monthly condition on Lakes Superior, Michigan-Huron, Erie, and Ontario. From Plate 18, Table 29 has been compiled, which shows the approximate date of maximum and minimum monthly mean values of stage, storage, outflow, total supply, and local supply of Lakes Superior, Michigan-Huron, Erie, and Ontario.

TABLE 29.

DATE OF MAXIMUM AND MINIMUM VALUES OF MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES.

Lake.	Stage.	Storage.	Outflow.	Total Supply.	Local Supply.
Superior, maximum	Sep. 20	May 20	Sep. 1	May 25	May 25
Superior, minimum	Mar. 20	Dec. 10	Mar. 15	Dec. 15	Dec. 15
Michigan-Huron, maximum	July. 20	May 5	Aug. 1	May 10	May 5
Michigan-Huron minimum	Feb. 1	Nov. 1	Feb. 20	Nov. 10	Oct. 25
Erie, maximum	Jun. 25	Apr. 5	July 20	Apr. 5	Apr. 5
Erie, minimum	Feb. 10	Oct. 1	Feb. 20	Oct. 10	Oct. 1
Ontario, maximum	July 1	Apr. 5	July 1	May 5	Apr. 25
Ontario, mimimum	Dec. 10	Sep. 10	Feb. 10	Jan. 20	Sep. 25

92. The mean monthly stage cycle on Lake Superior has fluctuated between 602.79, in September, and 601.77, in March, a change of 1·02 feet. A plus storage has occurred during the months of April to September, inclusive, while a minus storage has occurred during the months of October to March, inclusive. The maximum mean monthly storage has been 95900 cubic feet per second, while the minimum has been —91100. The discharge, or outflow, has increased from March 15 to September 1, while it has decreased from September 1 to March 15. The mean monthly outflow has ranged between 92800 and 68000 cubic feet per second. The total supply has increased values from December to May, and has decreased values from May to December. The mean monthly total supply has had a maximum value of 175700 cubic feet per second, and a minimum value of 10700 cubic feet per second. This minus value, which occurs in December, shows conclusively that the evaporation from Superior may be greater than the precipitation on lake surface and run-off from its watershed. The mean monthly supply, to Superior, in January, has been only 2300 cubic feet per second, which proves that evaporation on lake surface is nearly equal to the precipitation on lake surface and run-off from the tributary watershed for that month.

93. The mean monthly stage of Lake Michigan-Huron has fluctuated between 581·90, in July, and 580·93, in January and February, a range of 0·98 foot. The storage on Michigan-Huron has been positive from February to July, inclusive, while it has been negative from August to January, inclusive. The maximum and minimum mean monthly storage values have been +132300 and —112200 cubic feet per second, respectively. The mean monthly outflow through the Detroit River has fluctuated from 219700, in August, to 175600 cubic feet per second, in February. This minimum discharge value is probably too large. The mean monthly total supply has had a maximum value of +337700 cubic feet per second, in May, and a minimum value of +96200, in November. The mean monthly local supply to Michigan-Huron has fluctuated between +257800 cubic feet per second, in May, and +8200 cubic feet per

second, in October. During October and November, the local supply has been so small that the evaporation from the lake surface has been about equal to the precipitation on lake surface and run-off from the tributary watershed.

94. The mean monthly stage on Lake Erie has ranged from 57·324 in June, to 572·03, in February, a fluctuation of 1·21 feet. The storage on Erie has had a positive value from February to June, inclusive, and a negative value from July to January, inclusive. The mean monthly storage has had a maximum value of +44100 cubic feet per second, in April, and a minimum value of —31100 cubic feet per second, in September. The outflow has fluctuated between 225700 cubic feet per second, in July, and 198100 cubic feet per second, in February. The mean monthly total supply has had a maximum value of +255700 cubic feet per second, in April, while it has fallen to a minimum value of +179200 cubic feet per second, in October. The mean monthly local supply on Erie has had a positive value from January to June, inclusive, and a negative value from July to December, inclusive. During these last six months, July to December, inclusive, the evaporation on the surface of Lake Erie has been greater than the precipitation on the lake surface and run-off from the tributary watershed. The maximum mean monthly local supply of +56100 cubic feet per second occurred in April, while the minimum of —31800 cubic feet per second occurred in October.

95. The mean monthly stage of Lake Ontario has ranged from 246·95, in June, to 245·57 in December, a fluctuation of 1·38 feet. The storage has shown a positive value from January to June, inclusive, and a negative value from July to December, inclusive. The mean monthly storage has had a maximum value of +34800 cubic feet per second, in April, and a minimum value of —28700 cubic feet per second, in September. The mean monthly outflow through the St. Lawrence River has fluctuated between 283600 cubic feet per second, in July, and 219300 cubic feet per second, in February. The mean monthly total supply has had a maximum value of +297500 cubic feet per second, in May, and a minimum value of +225500 cubic feet per second, in January. The mean monthly local supply to Ontario has ranged from +83800 cubic feet per second, in April, to +18000 cubic feet per second, in September.

96. The maximum mean monthly supply stage of each lake of the Great Lakes has occurred at different times in the different lakes. This has been equally true with respect to the minimum stage. The maximum discharge of any lake does not occur at the time of the maximum total supply. The minimum discharge of any lake does not occur at the time of the minimum total supply. The maximum local supply of any lake does not occur at the same time as the maximum total supply; neither does the minimum local supply of any lake occur at the same time as the minimum total supply.

97. Table 30 shows the ratios, $R_{MAX.}$, between the maximum value of mean monthly discharge and the maximum value of mean monthly total supply for each lake in the system; the time interval in days, $T_{MAX.}$ which elapsed between the date of the occurrence of the maximum value of mean monthly total supply to any lake and that of the maximum value of mean monthly discharge from that lake; and the time interval, in days, $T_{MIN.}$, which elapsed between the date of the occurrence of the minimum value of mean monthly total supply to any lake and that of the minimum value of mean monthly discharge from that lake.

TABLE 30.

RATIOS—$R_{\text{MAX.}}$, $T_{\text{MAX.}}$, AND $T_{\text{MIN.}}$,

Lake.	$R_{\text{Max.}}$	$T_{\text{Max.}}$	$T_{\text{Min.}}$
Superior	0·524	98 days	91 days
Michigan-Huron	0·746	82 days	101 days
Erie	0·884	76 days	132 days
Ontario	0·955	56 days	20 days

98. The ratio, $R_{\text{MAX.}}$, increases with each succeeding lake in the Great Lakes system. The maximum mean monthly outflow from Superior has been about 52 per cent of the maximum mean monthly total supply to that lake, while the maximum mean monthly outflow from Ontario has been about 96 per cent. of the maximum mean monthly total supply to that lake.

99. In order that a comparoisn of the several supply factors of the several lakes can be intelligently made, part of the data given in Table 28 has been expressed in cubic feet per second per square mile of watershed, Table 31 gives the mean monthly values of storage, outflow, and total supply of Lakes Superior, Michigan-Huron, Erie, and Ontario in terms of the total watershed area, including lake surface, above the lake's outlet, and of local supply of the same lakes in terms of the tributary local watershed area including lake surface. An inspection of this table shows that the mean monthly outflow from these several lakes of the Great Lakes system has been remarkably uniform. The maximum value for Superior has been 1·22 cubic feet per second per square mile, while the minimum value has been 0·89 cubic foot per second per square mile. The maximum value for Michigan-Huron has been 1·00 cubic foot per second per square mile, while the minimum value has been 0·80 cubic foot per second per square mile. The maximum value for Erie has been 0·89 cubic foot per second per square mile, while the minimum value has been 0·78 cubic foot per second per square mile. The maximum value for Ontario has been 0·99 cubic foot per second per square mile, while the minimum value has been 0·76 cubic foot per second per square mile.

100. The mean monthly total supply to Superior has fluctuated between 2·31 cubic feet per second per square mile and —0·14 cubic foot per second per square mile. That to Michigan-Huron has fluctuated between 1·53 cubic feet per second per square mile and 0·44 cubic foot per square mile. That to Erie has fluctuated between 1·00 cubic foot per second per square mile and 0·70 cubic foot per second per square mile. That to Ontario has fluctuated between 1·03 cubic feet per second per square mile and 0·78 cubic foot per second per square mile.

101. The mean monthly local supply to Superior has fluctuated between 2·31 cubic feet per second per square mile and —0·14 cubic foot per second per square mile. That to Michigan-Huron has fluctuated between 1·79 cubic feet per second per square mile and 0·06 cubic foot per second per square mile. That to Erie has fluctuated between +1·62 cubic feet per second per square mile and —0·92 cubic foot per second per square mile. That to Ontario has fluctuated between +1·62 cubic feet per second per square mile and 0·55 cubic foot per second per square mile. The average local supply to Erie is considerably less than that to the other lakes. This is explained in part by the southerly position of the lake in the chain, the general direction of its principal axis coinciding with the direction of the prevailing winds, its shallow depth, and

errors in winter discharge values of Detroit River,—all of which tend to decrease the local supply factor.

102. A comparison of the total supply values with the outflow or discharge values, expressed in cubic feet per second per square mile, shows the regulating effect of reservoirs on stream flow. Without reservoirs, the run-off from the lake's watershed is discharged immediately, while, with reservoirs, the run-off is stored and discharged at an approximate uniform rate.

THE REGULATION OF LAKE ERIE AS PROPOSED BY THE UNITED STATES BOARD OF ENGINEERS ON DEEP WATERWAYS.

103. The United States Board of Engineers on Deep Waterways, in 1900, reported on the regulation of Lake Erie, in appendix 6 of their report. The scheme, as proposed by them, consisted of a submerged weir, with regulating sluices, at the outlet of Lake Erie near the angle in the Bird Island Pier, by which the level of the lake might be held at or near some fixed stage. The report says:

'The regulation of the level of the lake implies the maintenance of its surface at or near some fixed stage, to accomplish which the discharge must be so controlled that it will be at all times approximately equal to the difference between the supply of water to the lake and evaporation from the lake surface.'

And further, in relation particularly to Lake Erie, the report states:

'To regulate the level of Lake Erie so as to maintain its surface near some fixed place of reference will require such control of the outflow through Niagara River that the storage which would naturally occur in the lake will be discharged during the first half of the year and the outflow will be diminished a like amount during the last half of the year. This modification of outflow will not materially change the total volume of discharge for any entire year and will amount to only one-fifth of the variation of discharge of the river for different years under present conditions. The effect of this modification of flow through Niagara River, on the level of Lake Ontario, will be to slightly increase the rate of rise in the spring and make the date of maximum stage a little earlier.'

104. The scheme of regulation, as proposed by the Board of Engineers on Deep Waterways, is to not allow the monthly mean stage of Lake Erie, at Buffalo, to rise above 574·5 feet, old levels, or 574·7 feet, 1903 levels, above mean tide at New York. The minimum monthly stage of lake surface, under regulation, is not definitely stated, but it is intimated to be about 573·7 feet, 1903 levels, in the following paragraphs taken from their report:

(1) 'The three months in which the supply was materially in excess of the discharge for proposed regulated stage were February, March, and April, during which the excess averaged 19000 cubic feet per second, corresponding to a rise of 0·2 foot in February, 0·2 foot in March, and 0·15 foot in April. Hence, if the level of the lake, when regulated, should be allowed to fall 0·6 foot every year after the close of navigation, it is probable that the excess of supply over discharge would never cause the surface to rise above the plane of regulation.'

(2) 'In the fall of 1875, the discharge of Niagara River was 60000 cubic feet per second less than the capacity of the regulating works; and, if the lake had been regulated, with the sluices of the regulating works all open, the surface would have been lowered one foot in about two months, or sufficient to have stored the escessive supply which occured in the spring of 1876, with a margin of 0·4 foot for contingencies.'

105. According to the discharge equation determined by the Board of Engineers on deep Waterways, the maximum discharge of Niagara River was 277270 cubic feet per second, with the lake regulated at stage 574·70, 1903 levels, and the minimum discharge was 178000 cubic feet per second at stage 570·70,

1903 levels. The discharge formula of Niagara River, deduced by the International Waterways Commission, is based upon more complete data and gives the minimum discharge as 261500 cubic feet per second at 574·7, 1903 levels, and the maximum as 166700 cubic feet per second at stage 570·7, 1903 levels. In this report, the latter discharge values are used instead of those of the Board of Engineers on Deep Waterways.

PRACTICAL REGULATION OF LAKE ERIE BETWEEN STAGES 573·7 AND 574·7, 1903 LEVELS.

106. In working out a practical scheme for regulation, it is quite necessary to set a definite elevation for the regulated stage of Lake Erie at the beginning of each month. The stage values used in this investigation are given in Table 32.

TABLE 32.

STAGE OF LAKE ERIE DESIRED ON FIRST OF MONTH, WITH REGULATED CONDITIONS.

Month.	Stage Desired at Beginning of each month.	Month.	Stage Desired at Beginning of each month.
January 1	573·8	August 1	574·0
February 1	573·7	September 1	574·0
March 1	573·7	October 1	574·0
April 1	573·8	November 1	574·0
May 1	573·9	December 1	573·9
June 1	574·0	January 1	573·8
July 1	574·0		

107. The maximum desired stage of water from June 1st to November 1st, inclusive, as shown in the above table, allows 0·7 foot for contingencies, which, as will be seen, is not adequate. The regulation of the elevation of the level of Lake Erie between stages 573·7 and 574·7 is a difficult proposition on account of the variation in total supply. It is impossible to estimate this factor with any degree of accuracy on account of the fluctuation of inflow, precipitation, run-off, and evaporation. This fact is very strongly brought out in the data and results shown in Table 33 and Plate 19, 'Regulation of Lake Erie between stages 573·7 and 574·7.' The difference between the expected total supply and the actual total supply for any one month has been as great as +47800 cubic feet per second, in April, 1891, and—40200 cubic feet per second, in April, 1892, which would have caused a difference in the expected change in the stage of Lake Erie of 0·4 to 0·5 foot. In June, 1892, (see Table 33) the lake level is supposed to have reached 574.0 on the 1st of July, and regulating works are assumed to have been set to give a discharge that would bring the lake to this stage by the first of the following month, but, owing to the increase in the actual total supply over the expected total supply, the lake would have risen to 574·64, which is 0·64 foot more than the desired and estimated stage. This unlooked-for variation in a high-water year, such as 1876, might prove disastrous if the lake level were at or near stage 574·7. By examining Table 33, it is also seen that the regulated level of Lake Erie would have fallen, in most years, during some of the winter months, to 573·3, approximately, or 0·4 foot below the minimum stage set by the Board of Engineers on Deep Waterways, but would have risen above 573·7

by the opening of the season of navigation. With the proposed scheme of regulation, for the period from 1890 to 1906, inclusive, the level of Lake Erie would have risen 0·04 foot above 574·7, in June, 1892.

108. The period from 1890 to 1906, inclusive, does not include an extreme high-water year. If the proposed scheme of regulation had occurred in 1876, when the monthly mean stage of Lake Erie reached 574·5, in June, then the assumed maximum level (574·7) would have been exceeded, during April to July, inclusive by 0·03, 0·19, 0·20, and 0·05 foot, respectively (see Table 33).

109. During the period from 1890 to 1906, inclusive, with regulation, the mean level of Lake Erie would have been raised from 572·1 to about 573·9, an increase in mean stage of 1·8 feet. During the low-water year of 1895, the mean annual level, with regulation, would have been 2·57 feet higher than the actual stage. The extreme low monthly mean stage of 570·71, in November, 1895, would have been raised by regulation to 573·59, an increase of 2·88 feet. The actual oscillation in monthly mean water level of Lake Erie has been about 3·89 feet. With regulation as proposed, the range of monthly mean oscillation would have been reduced to 1·43 feet during the year, and to 1·14 feet during the navigation season.

110. Perfect regulation is impossible. The monthly increase in stage of Lake Erie, with natural conditions, is frequently 0·4 to 0·5 foot; occasionally exceeds 0·8 foot; and has been as great as 0·98 foot. Daily oscillations in the stage are occasionally as large as 7 or 8 feet, and hourly variations sometimes exceed 2 feet. Southwesterly storms on the lake raise the water level at Buffalo and lower it at Amherstburg by several feet from the normal. This difference of level has been as large as 15 feet with the severest storms. The control this daily and hourly variation in stage of Lake Erie within small limits is impossible.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 573·7 AND 574·7 ON WATER LEVELS OF LAKE ONTARIO AND ST. LAWRENCE CANALS.

111. The effect of the regulation of the stage of Lake Erie between 573·7 and 574·7, on the water levels of Lake Ontario, for the period from 1890 to 1906, inclusive, is shown on Plate 20, which illustrates the increased range in stage of Lake Ontario and the detrimental effect to navigation in the St. Lawrence canals due to the proposed regulation of Lake Erie under the scheme proposed by the Board of Engineers on Deep Waterways.

PRACTICAL REGULATION OF LAKE ERIE BETWEEN STAGES 572·0 AND 574·5, 1903 LEVELS.

112. Inasmuch as it is deemed impracticable to regulate the monthly mean stage of Lake Erie between stages 573·7 and 574·7 feet above mean tide at New York, as proposed in the plan of the Board of Engineers on Deep Waterways, the investigation was continued to determine the limits between which the regulation of the monhly mean stage of Lake Erie would be practicable.

113. As in the previous plan of lake regulation, a definite elevation for the stage of the lake on the first of each month has been assumed. These values represent the limits within which it would be necessary to attempt to hold the stage of Lake Erie so that the maximum and minimum monthly mean water levels of 574·5 and 572·0, respectively, would not be exceeded. Table 34 shows the assumed elevations desired on the first of month, of the water surface of Lake Erie, for regulation of its monthly mean stage between 572·0 and 574·5.

TABLE 34.

STAGE OF LAKE ERIE DESIRED ON FIRST OF MONTH WITH LAKE REGULATED BETWEEN 572.0 AND 574.5.

Month.	Stage desired at Beginning of each month.	Month.	Stage Desired at Beginning of each month.
January 1	572·3	August 1	572·5
February 1	572·2	September 1	572·5
March 1	572·2	October 1	572·5
April 1	572·2	November 1	572·5
May 1	572·3	December 1	572·4
June 1	572·4	January 1	572·3
July 1	572·5		

114. An inspection of Table 34 shows that 2·0 feet and 0·2 foot have been allowed for the actual fluctuations from the desired maximum and minimum monthly mean stages, respectively, of Lake Erie, with regulation. This extreme allowable fluctuation from the desired maximum is necessitated by the extreme high water of 1876, during which year the surface of Lake Erie, at Buffalo, reached a mean level of 574·49, in June, or but 0·01 foot less than the maximum monthly mean stage allowable with regulation.

115. As 1876 is the controlling high-water year, so 1895 is the controlling low-water year. Computations have been made for these two extreme years instead of for the period from 1890 to 1906, inclusive, as in the investigation of the scheme outlined by the Board of Engineers on Deep Waterways.

116. Table 35 and Plate 21 show that, with regulation, the water levels of Lake Erie, at Buffalo, differ but slightly from the actual levels for the year 1876, while for the low-water year of 1895 the annual mean level for the extreme low-water months of November and December (both in the navigation season) would be increased from 570·71 and 570·97 to 572·09 and 572·34, respectively, or a change of +1·38 feet and +1·37 feet, respectively.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572·0 AND 574·5, ON WATER LEVELS OF LAKE ONTARIO AND ST. LAWRENCE CANALS.

117. Any change in the outflow of Lake Erie will change the water levels of Lake Ontario. If the inflow to Ontario is increased, the lake level will rise, and with decreased inflow the level will fall. Table 36 and Plate 21 show the effect on the water levels of Lake Ontario for the years of 1876 and 1895, if Lake Erie stage had been regulated between stages 572·0 and 574·5 for those years. The effect of the regulation of Lake Erie would have been to increase the fluctuation in stage of Lake Ontario, causing higher stage in spring and lower stage in the autumn than under actual conditions.

118. For the high-water year of 1876, during which time the regulated inflow would have differed but slightly from the actual, there would have been no appreciable increase in the fluctuation in stage on Lake Ontario, and at no time during the year would the regulated stage differ from the actual by more than 0·12 foot. In 1895, however, a low-water year on Lake Ontario as well as on Lake Erie, the fluctuation would have increased with the result that during

the months from September to December, inclusive, the regulated stages would have fallen to 243·70, 243·26, 243·08, and 243·33, respectively, or 0·34, 0·38, 0·33, and 0·18 foot, respectively, below the actual stages for those months.

119. During an extended period, such as from 1890 to 1906, inclusive, differences of 0·4 to 0·5 foot between the actual stage of Lake Ontario and the stage that would have prevailed under regulated conditions on Lake Erie would be of frequent occurrence. Unfortunately, these variations, with respect to actual stage, are generally negative during the period of low water and positive during the period of high water. Such conditions, caused by regulating Lake Erie, would injuriously affect navigation in the St. Lawrence canals and would decrease the draft of vessels by 0·4 to 0·5 foot, in the Galop canals, and 0·7 to 0·8 foot, in the Morrisburg canals. Barges and tows that now load to 14 feet draft would be compelled to load to not more than 13·2 or 13·3 feet draft during September, October, and November, in most years, and in some years, during the entire season of navigation.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572·0 AND 574·5, ON WATER LEVELS OF NIAGARA RIVER.

120. By the proposed system of regulation, the stage of water in the Niagara River would not fluctuate through any greater range than under actual conditions. During the winter months, more frequent low water would probably occur under regulation than under actual conditions, in which case the power companies at Niagara Falls would probably have more difficulty in keeping the channels to their intakes free from ice. During the fall months, navigation in the river might be slightly interfered with owing to the storage in the lake of a part of the natural discharge.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572·0 AND 574·5, ON WATER LEVELS OF LAKE ST. CLAIR, LAKE MICHIGAN-HURON AND CONNECTING WATERS.

121. By the proposed regulation of Lake Erie between stages 572·0 and 574·5, the mean level of this lake would have been raised about 1 foot. This increase in stage would have decreased the mean slope in the Detroit River and would have caused Lake St. Clair to rise until the discharge through the Detroit River had a value equal to the discharge under natural conditions for the same period. An examination of Tables 8 and 9 shows that the mean stage of Lake St. Clair, at Windmill Point, was 575·40, and that of the lower end of the Detroit River, at Amherstburg, was 572·84. From equation 30, the discharge of the Detroit River is computed to be 204900 cubic feet per second for mean stages of 575·40, at Windmill Point, and 572·84, at Amherstburg. For this river-discharge value and with the stage at Amherstburg increased by 1·0 foot, the amount that mean level of Lake Erie would have been raised by triangulation, it is found that the stage of Lake St. Clair, at Windmill Point would eventually rise 0·61 foot. This value represents the effect on the stage of Lake St. Clair due to the increase of 1·0 foot in mean stage of Lake Erie under regulation.

122. The rise between actual and regulated low-water stage of Lake Erie would be greater than the corresponding rise between actual and regulated high-water stage. The effect of this would be to slightly lessen the discharge of the Detroit River at low stage and to slightly increase it at high stage.

123. As backwater from Lake Erie raises the water level of Lake St. Clair, so backwater from Lake St. Clair raises the water level of Lake Michigan-Huron. For a given flow in the Detroit River, an increase in the stage of Lake Erie causes an increase in the stage of Lake St. Clair; likewise, for a given flow in the St. Clair River, and increase in the stage of Lake St. Clair causes an increase in the stage of Lake Michigan-Huron. By the method used above, the effect on the water level of Lalke-Michigan-Huron, caused by 0·61 foot backwater on Lake St. Clair, due to the regulation of Lake Erie, has been computed to be 0·27 foot rise.

124. A study of Plate 21 shows that for a year of excessive, or above-normal supply, such as 1876, the regulation of Lake Erie would not materially improve navigation. In 1895, a year of deficient supply, the mean level during the eight-month season of navigation would have been increased from 571·31 feet under natural conditions, to 572·41. under regulated conditions, and navigation on Erie would have been improved by an increased stage of 1·1 feet. The regulation of Lake Erie, between stages 572·0 and 574·5, would raise extreme low stage for the navigation season by at least one foot, without an appreciable increase in the extreme high stage. This increase in low stage is equivalent to deepening every harbor and channel in Lake Erie by that amount; in the Detroit River and Lake St. Clair, by at least 0·61 foot; and in the St. Clair River and Lake Michigan-Huron by at least 0·27 foot.

REGULATION OF LAKE SUPERIOR.

125. The regulation of the stage of Lake Superior has been suggested as a means (first) for improving navigation on that lake, and (second) to compensate for the diversion of water from Lake Michigan-Huron through the Chicago Drainage Canal.

126. This Commission has already recommended in its report upon the conditions existing at Sault Ste. Marie that "the level of St. Marys River, above the rapids, shall be maintained between the elevations 601·7 and 603·2 above mean tide at New York." The monthly mean stage of St. Marys River, above the rapids, has not risen above 603·2 since 1860, except in September and October, 1869, and July, August, and September, 1876. It has fallen below 601·7 on numerous occasions, generally during the winter months. In 1879 and 1891, the monthly mean stage did not exceed 601·5, while in 1892 it exceeded 601·7 in only one month. The fall in the water level of the St. Marys River above the rapids, below 601·7, for the ice months of January to April, inclusive, does not interfere with navigation on Lake Superior. The monthly mean water level of Lake Superior was below 601·7 about 20 per cent of the navigation season (May to December, inclusive) from 1860 to 1888, inclusive. For this cycle of years, the regimen of the St. Marys River had not been materially altered by artificial works. With the completion of the International Bridge piers and approaches in 1888, and the shutting off of spans 1 and 2 of this bridge from the rapids by the Chandler-Dunbar Water Power Company, in 1892, these two principal obstructions to the natural outflow from Lake Superior have raised the water level so that it has not fallen below 601·7 more than about 2 per cent of the navigation season from 1893 to 1907, inclusive. The difference can not be attributed to the variation in the total supply, or water-yield, to Lake Superior; for, as a matter of fact, the average total supply for the period from 1860 to 1888, inclusive, was about 4400 cubic feet per second greater than for the period from 1893 to 1907, inclusive.

127. The construction of the compensating works at the head of the St. Marys Rapids by the Michigan Lake Superior Power Company, in 1901 and 1902, cut off a flow of about 9900 cubic feet per second. The 8500 cubic feet

per second of water used by this company since 1905 nearly neutralizes the effect of these works.

128. The regulation of Lake Superior during the navigation season, between the elevations 601·7 and 603·2, as measured by the level of the St. Marys River above the rapids, has been accomplished under the conditions that did exist, and no further works seem to be necessary until a change in the artificial diversions at Sault Ste. Marie is made.

129. If the monthly mean level of Lake Superior were to be controlled during the navigation season within a smaller fluctuation than 1·5 feet, then the outflow through the St. Marys River would have to be artificially controlled. In order to eliminate the monthly mean fluctuation in large natural reservoirs, such as Lake Superior and the other lakes in this systen, it would be mecessary to increase the fluctuations of outflow to correspond to the fluctuations of total supply to that reservoir, to accomplish this result on Lake Superior, the monthly mean outflow would have had a maximum value of 333300 cubic feet per second, in August, 1869, and a minimum value of −106600 cubic feet per second, in December, 1870. Such fluctuations in outflow are impossible, since the minimum discharge of any stream is zero. When the total supply is minus, the level of the lake or reservoir will fall even if the outflow is entirely shut off.

130. The question that now presents itself, since perfect regulation of Superior is impossible, is: Can the fluctuations in stage of Lake Superior be materially reduced; and if so, what would be the effect on the lower lakes. An examination of Table 24 shows that during November and December, 1870, and January, 1871, the total monthly supply to Lake Superior for these three consecutive months was −99500, −106600, and −42900 cubic feet per second, respectively, equivalent, collectively, to a total depth on the lake surface of −0·732 foot. The level of Lake Superior actually fell 1·41 feet during this period, but, even if the outflow through the St. Marys River had been entirely shut off, the lake would still have fallen over eight and three-quarters inches. During May, June, and July, in the high-water year of 1876, the total monthly supply to Lake Superior was 303300, 291200, and 205000 cubic feet per second, respectively,—a total of 799500 cubic feet per second, equivalent to a depth on lake surface of +2·351 feet. The outflow through the St. Marys River for the corresponding period was 95800, 109200, and 120000 cubic feet per second, respectively, or an average monthly flow of 108300 cubic feet per second. Granting that this enormous supply of water could have been predicted—an impossibility—and that the St. Marys River could have discharged twice the average monthly outflow, or 216600 cubic feet per second, for three months, through artificial works and channels, which would be very costly to construct, Lake Superior would still have risen over 5¼ inches.

131. If the monthly oscillations in stage of Lake Superior could be materially reduced, then the monthly mean flow through the St. Marys River would fluctuate more than it actually does. Under present conditions, the outflow through the St. Marys River is the greatest during August, September, and October, when the stage of Lake Michigan-Huron is falling very rapidly. Under these natural conditions, the water from Lake Superior aids in the attempt of nature to hold the stage of Lake Michigan-Huron at a fixed elevation. If the outflow from Lake Superior in an average year were increased as much as 50 per cent during August, September, and October, the level of Lake Michigan-Huron would be raised only about 0·1 foot per month for these months, since the discharge through the St. Marys River is not the supply factor that produces the principal effect on the stage of Lake Michigan-Huron.

132. These cases show, first, that the artificial regulation of Lake Superior would not materially decrease the present fluctuation of water level; second, that Lake Superior is one of the best naturally regulated bodies of water in the

world; and, third, that the effect of the artificial regulation of the level of Lake Superior on the level of Lake Michigan-Huron would produce only insignificant results.

DIVERSION OF WATER THROUGH CHICAGO DRAINAGE CANAL, THE EFFECT OF DIVERSION ON LAKES MICHIGAN-HURON, ERIE, AND ONTARIO, AND THE REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION AT CHICAGO.

133. The Chicago Drainage Canal has diverted water from Lake Michigan-Huron since 1900. This has lowered the level of Lakes Michigan-Huron, St. Clair, Erie, and Ontario, regardless of the fact that these lakes are at higher stages than they were when the canal was opened. These higher stages are due to the increase in the quantity of water supplied since 1900. If this supply had not been increased, then the stages of the lakes would have been actually less. Plates 22, 23, and 24 show the monthly loss of level on Lakes Michigan-Huron, Erie. and Ontario, respectively, under the actual diversion through the Chicago Drainage Canal, and also under assumed diversions of 10000 and 14000 cubic feet per second.

Table 37.—Loss of Level on Lakes Michigan-Huron, Erie, and Ontario under the actual Diversion and under assumed Diversions of 10000 and 14000 c. f. s. through the Chicago Drainage Canal, 1900-1907, inclusive.

Lake.	Loss of Level in Inches.		
	Actual Diversion.	Assumed Diversion of	
		10000 c. f. s.	14000 c. f. s.
Michigan-Huron	2–$\frac{5}{8}$	6–$\frac{1}{2}$	9–$\frac{5}{8}$
Erie	2–$\frac{1}{2}$	5–$\frac{7}{8}$	8
Ontario	1–$\frac{7}{8}$	4–$\frac{1}{4}$	6

134. The stage of Lake Michigan-Huron is 2 5-8 inches lower than it would have been if there had not been any water diverted through the Chicago Drainage Canal. Likewise, the stages of Lake Erie and Lake Ontario are 2½ and 1 $\frac{7}{8}$ inches lower, respectively, than they would have been with no diversion at Chicago. If the quantity of water diverted through the canal had been as much as 10000 or 14000 cubic feet per second, then the effect would have been proportionately greater.

135. Since the effect of the diversion is to lower the level of the lakes and connecting channels of the Great Lakes system, with the exception of Lake Superior and the upper St. Marys River, and as this effect will increase in the quantity of water diverted, therefore, the question presents itself: Can the present diversion or future diversions through the Chicago Drainage Canal be compensated for by the use of Lake Superior as a storage reservoir, so that the level of the lakes below Superior will not be lowered?

136. The longest low-stage period of outflow from Lake Superior has been selected in order to obtain a solution to the question. An examination of Plates 2 to 5, inclusive, shows that such a period occurred between June, 1888, and August, 1893. The average flow for the low-water year of 1892 was 65700 cubic feet per second. Assuming a continuous discharge from Superior of the average flow for that year, and, in addition, first, 4000 and, second, 14000

cubic feet per second, respectively, to compensate for a diversion of these amounts through the Chicago Drainage Canal, or a total continuous discharge of, first, 69700 cubic feet per second, and, second, 79700 cubic feet per second, respectively, between June 1, 1888, and August 31, 1893, then the regulated stages of all the lakes in the Great Lakes system would have differed materially from the actual stages. Plate 25 and Tables 38, 39, 40, 41, and 42 show these changes in stage of Lakes Superior, Michigan-Huron, Erie, and Ontario, due to regulation of outflow from Lake Superior to compensate for diversions through the Chicago Drainage Canal of 4000 and 14000 cubic feet per second.

137. To compensate for a diversion of 4000 cubic feet per second through the Chicago Drainage Canal, with the continuous discharge of water from Lake Superior of 69700 cubic feet per second between June 1, 1888, and August 31, 1893, the stage of te St. Marys River, as measured at Sault Ste. Marie, (above the locks) would have been higher than it was actually. In August, 1893, the level of Superior would have returned to approximately the actual stage. Under assumed conditions, the mean stage of Lake Superior would have been increased during the period from June, 1888, to August, 1893, at the expense of the decrease in stage of Lakes Michigan-Huron, Erie, and Ontario. The cumulative effect of the constant discharge of 69700 cubic feet per second from Lake Superior during this five-year period would have been to lower the monthly mean stage of Lakes Michigan-Huron from 579·88 to 579·53, and from 579·82 to 579·48, in November and December, 1891, respectively. These stages would have been only 0·36 and 0·48 foot higher, respectively, than the actual stages for the corresponding months of November and December in the extreme low-water year of 1895, and would have been 0·23 and 0·28 foot lower, respectively, than the mean stage for the entire navigation season of 1895, when the shipping interests were so seriously affected. This constant discharge of water from Lake Superior would also have lowered the monthly mean stage of Lake Erie from 571·21 to 570·89, and from 571·28 to 570·96, in November and December, 1891, respectively, which would have been only 0·19 and 0·10 foot higher, respectively, than the actual stages in November and December, 1895. The monthly mean stage of Lake Ontario would have been decreased by this discharge from Lake Superior from 244·44 to 244·19, and from 244·41 to 244·16, in November and December, 1891, respectively.

138. At the end of August, 1893, the water stored in Lake Superior would have been delivered to the lower lakes, and no storage water would have been available, in addition to the actual supply, to compensate for the diversion of water through the Chicago Drainage Canal, and prevent the mean levels of Lakes Michigan-Huron, Erie, and Ontario falling below the actual stages.

139. The monthly mean discharge of the St. Marys River was greater than 69700 cubic feet per second in September, October, and November, 1893. This excess would have allowed 6900, 5800, and 4800 cubic feet per second of water, respectively, to have been stored in Lake Superior in these months. The storage of this volume of water should have temporarily taken it away from the supply to Lake Michigan-Huron, and would have lowered the level of that lake temporarily. Later, when this stored water would have been discharged into the lakes below, their stages would have been the same as under natural conditions, and during the interval between the storage and discharge of this water the diversion of water through the Chicago Drainage Canal would have lowered the mean level of Lakes Michigan-Huron, Erie, and Ontario as it has under actual conditions. If the outlet were to have been artificially changed so that the St. Marys River could have discharged 4000 cubic feet per second in addition to the actual discharge, beginning with September, 1893, in order to compensate for an assumed diversion of this amount at Chicago, then it would have been only a few years before Lakes Superior would have fallen so low in stage that navigation would have been seriously interfered with.

140. To compensate for a diversion of 14000 cubic feet per second through the Chicago Drainage Canal, with the continuous discharge of water from Lake Superior of 79700 cubic feet per second between June 1, 1888, and August 31, 1893, the stage of the St. Marys River, as measured at Sault Ste. Marie, (above the locks) would have been lower by 1.4 feet than it was actually. This increased discharge from Lake Superior would produce the same effect on the lower lakes as the effect of the previous discharge of 69700 cubic feet per second, since the increased outflow from Lake Superior would be taken by the additional diversion through the Chicago Drainage Canal. The stage of the St. Marys River, at Sault Ste. Marie, (above the locks) would have fallen, in May 1893, to slightly below 600.0, which would have seriously interfered with the navigation of Lake Superior by the present lake vessels. At the end of this five-year period, the level of Lake Superior would have been extremely low and water would not have been available for storage in Lake Superior for the next low-water period.

141. The annual mean stage of the St. Marys River, above the locks, fell to 600.96, in 1879. This minimum value must not be taken as a criterion for permissible low water for navigation purposes; neither should it be assumed that the minimum annual mean stage on the remaining lakes, as a permanent level, would be satisfactory to navigation.

142. The artificial storage of water in Lake Superior must be commenced by shutting off the transmitted supply to the lakes below Superior in the Great Lakes system. When the stored water is allowed to flow from Lake Superior, the total supply to Lakes Michigan-Huron, Erie, and Ontario will be the same as under actual conditions, and the mean level of these lakes will remain unchanged.

143. An artificial storage of water in Lake Superior has taken place, beginning with the construction of the International Bridge and its approaches in 1888. The storing of this water in Superior has withheld it temporarily from the lakes below, and, as a result, the stages of the latter have been changed from what they would have been if there had been no artificial changes in the outlet to Lake Superior. Plates 26, 27, 28, and 29 show the monthly mean stages of the Great Lakes under actual conditions and as they would have been if no artificial works had been built in the upper St. Marys River.

144. An inspection of Plate 26 shows that the artificial storage of water in Lake Superior, created by the building in the upper St. Marys River of the International Bridge and approaches in 1888, of cutting off from the rapids the flow through spans 1 and 2 of this bridge from the American shore by the Chandler-Dunbar Water Power Company in 1892, and of building the compensating works immediately above the bridge, on the Canadian side, by the Michigan Lake Superior Power Company in 1901, has raised the monthly mean level of Lake Superior approximately 1 foot (0·966) in August, 1904. Owing to diversions of water at Sault Ste. Marie for power and other purposes, this effect is less by about 0·4 foot than the computed ultimate rise due to these obstructions. Since January, 1905, when the Michigan Lake Superior Power Company began to divert approximately 8500 cubic feet per second of water from the river for power purposes, the difference between the actual and original efflux stages has decreased to approximately 0·6 foot, a loss in level between 1904 and 1907 of 0·4 foot. Under original efflux conditions, the monthly mean level of Lake Superior would have fallen from 601·02 to 600·76 in April, 1892; from 601·01 to 600·82, in February, 1893; from 601·46 to 600·92, in March, 1898, and from 601·88 to 601·02, in March, 1903. The annual mean stage of Lake Superior, for 1904, would have been 601·84 under original conditions, while it was 602·71 under actual conditions. This artificial storage of water, due to the obstructions at the controlling section of the upper St. Marys River,

partly explains why the stage of Lake Superior has been gradually rising while the stages of the lower lakes have not followed the same general upward trend.

145. The storing of water in Lake Superior has had its effect on the stage of the lower lakes. An increase in the transmitted supply from Lake Superior raises the stage of Lake Michigan-Huron an amount equal to the increase divided by the increment of discharge through the St. Clair River. The amount of additional water from Lake Superior that would have flowed into Lake Michigan-Huron between December, 1888, and December, 1904, is equivalent to the decrease in storage on Superior. This quantity represents a slice 0·87 foot thick over the entire surface of Lake Superior, equivalent to an average monthly increase in discharge of 1530 cubic feet per second through the St. Marys River between December, 1888, and December, 1904, inclusive. Under actual conditions, this increase in discharge would not be a constant quantity but would change according to the effect of the obstruction or the diversion. Plate 27 shows a comparison of the monthly mean water levels of Lake Michigan-Huron under actual and original efflux conditions of the St. Marys River. The effect of storing water in Lake Superior by the cutting off of spans 1 and 2 of the International Bridge at Sault Ste. Marie, in 1892, by the Chandler-Dunbar Water Power Company, was to lower Lake Michigan-Huron by about 0·15 foot in 1894 and 1895. In 1896, the Lake Superior Power Company began to use water for power purposes on a large scale, which partially counteracted the effect of the obstructions. In 1902, the effect of the compensating works of the Michigan Lake Superior Power Company was to lower Lake Michigan-Huron by about 0·15 foot. In 1905, the Michigan Lake Superior Power Company began the diversion of water through their canal on the American side, which has, apparently, raised the stage of Lake Michigan-Huron about 0·1 foot, but in so doing it has been done at the expense of lowering Lake Superior by about 0·4 foot.

146. The effect on Lakes Erie and Ontario of the artificial storage of water in Lake Superior is slightly less than the effect on Lake Michigan-Huron. This decrease in effect is due to the increase in the increment of discharge of the outlets of Lakes Erie and Ontario. Plates 28 and 29 show a comparison of the monthly mean water levels of Lake Erie and of Lake Ontario, respectively, under actual and original efflux conditions of St. Marys River. While the effect of the cutting off ot the flow through spans 1 and 2 from the rapids of the St. Marys River occurred about December, 1892, it was not materially felt on Lake Michigan-Huron until the latter part of 1893; not in Lake Erie until the middle of 1894, and not in Lake Ontario until the end of 1894. The effect of the construction of the compensating works at Sault Ste. Marie by the Michigan Lake Superior Power Company is also noticeable on these lakes. All the other changes in stage on Lake Michigan-Huron are faithfully reproduced on the stage of Lakes Erie and Ontario, the only difference being that they occur a little later and the effect becomes slightly less on each lake lower in the series. Where the maximum effect on Lake Michigan-Huron was about 0·15 foot, it was 0·12 foot on Lake Erie, and about 0·10 foot on Lake Ontario.

147. The artificial storage of water in Lake Superior between December, 1888, and December, 1907, inclusive, by the placing of obstructions in the upper St. Marys River, has had the effect of raising the mean stage of Lake Superior by about 0·87 foot in 1904, and of lowering Lake Michigan-Huron, Lake Erie, and Lake Ontario, by a maximum of 0·15, 0·12, and 0·10 foot, respectively. This hydraulic experiment, which has been carried on since 1888, shows that the use of Lake Superior as a storage reservoir can not be successful if navigation is to be maintained unimpaired on Lake Superior and the St. Marys River.

REGULATION OF LAKE MICHIGAN-HURON.

148. To regulate the level of Lake Michigan-Huron near some fixed plane of reference would require regulating works at or near the head of the St. Clair River. The storage in the lake, that occurs in the first part of the year, could then be discharged through these works, while the outflow from the lake during the last half of the year could be diminished by an amount equal to the negative storage. An examination of Table 28 and Plate 18 shows that the monthly mean total supply to Lake Michigan-Huron for an average year has been as great as 337700 cubic feet per second, in May, and as small as 96200 cubic feet per second, in November. Plates 7 and 6 show that the maximum and minimum monthly mean total supply has been 470800 cubic feet per second, in June, 1883, and —32000 cubic feet per second, in September, 1871, respectively. The maximum monthly mean discharge from this lake, which occurred in July, 1883, has been determined as 274500 cubic feet per second. On the basis of the above extremes for total supply, to accomplish perfect regulation of this lake would necessitate provision for a maximum outflow of 470800 cubic feet per second, and a minimum of—32000 cubic feet per second. This required maximum outflow is 195400 cubic feet per second, or 71 per cent, greater than the actual maximum. If the outflow from Lake Michigan-Huron had been entirely shut off in September, 1871, the lake would still have fallen about 0·07 foot during that month. For the period of five months, August to December, 1871, inclusive, the average outflow from Lake Michigan-Huron, with perfect regulation, would have been only 43500 cubic feet per second; likewise, for the period of five months, August to December, 1894, inclusive, and for the months of September, October, and November, in the low-water year of 1895, the average outflow with perfect regulation would have been only 71700 and 46600 cubic feet per second, respectively. On account of the small quantity of water that would have flowed in the St. Clair and Detroit rivers during these three periods, the stage of these rivers, of Lake St. Clair, and of Lake Erie would have been lowered several feet below the lowest known monthly water levels, and present navigation on the Great Lakes, below Lake Michigan-Huron, would have been entirely suspended.

149. These examples that have been cited show that the perfect regulation of Lake Michigan-Huron at a fixed plane of reference is not feasible if it were possible to predict the quantity of water that nature would supply to any lake in any month.

150. The discharges of the St. Clair and Detroit rivers during the navigation season are comparatively uniform owing to the effect of the increased slopes in the rivers, counteracting the effect of the decreased stages in the lakes. With the regulation of Lake Michigan-Huron, the discharge would be greatly increased during April, May, June, and July, and greatly decreased during August, September, October, and November. The latter are the critical months for the navigators. Any change in the flow of these two rivers, whereby the fluctuation in discharge would be increased, would prove a detriment to navigation.

151. Granting that the regulation of Lake Michigan-Huron could be accomplished by artificial works, the effect on the stage of water in the St. Clair River, Lake St. Clair and Detroit River would be so serious that any benefit derived from the increased depths in Lake Michigan-Huron would be more than offset by the decreased depths in the St. Clair River, Lake St. Clair, Detroit River, and the western end of Lake Erie.

152. At the present time, the stage of Lake Michigan-Huron is partially regulated by natural agencies. Nearly every winter, nature forms a regulating

works in the St. Clair or Detroit river. These works consist of ice gorges, which retard the outflow from Lake Michigan-Huron, thereby storing water to be let out during the navigation season when it is so greatly needed in the lakes and connecting channels below Lake Michigan-Huron.

REGULATION OF LAKE ONTARIO.

153. To control the stage of Lake Ontario near some fixed level, regulating works could be constructed at the head of the Galop Rapids in the St. Lawrence River. These works would control the outflow from Lake Ontario and maintain the levels of the lake within definite limits. For perfect regulation, the storage in the lake must be diminished by the amount of the negative storage during the last half of the year. An examination of Table 28 and Plate 18, shows that, for an average year, the monthly mean total supply to Lake Ontario has fluctuated between 297500 cubic feet per second, in May, and 225500 cubic feet per second, in January, while the monthly mean outflow has varied from 283600 cubic feet per second, in July, to 219300 cubic feet per second, in February. The maximum monthly mean total supply has been as large as 382400 cubic feet per second, in April, 1870, and as small as 154100 cubic feet per second, in February, 1875, while the maximum monthly mean discharge has been as large as 351200 cubic feet per second, in May, 1862, and as small as 152200 cubic feet per second, in February, 1902. In order to accomplish perfect regulation without enlarging the river cross section, the stage of Lake Ontario must be held at such a level that the outflow can be as great as 382400 cubic feet per second, or 31200 cubic feet per second greater than the maximum discharge to date. This required maximum outflow is only 9 per cent greater than the actual maximum. For the low-water year of 1895, the average total supply was 185700 cubic feet per second, while the average outflow was 191 600 cubic feet per second. If the oscillations in the levels of Lake Ontario are to be decreased without exceeding the extreme high water of 248.95, then the level of the lake should be held at such a stage that it will never exceed this maximum limit in months of excessive supply. Two consecutive months of excessive supply occurred in April and May, 1862, when the water-yield was 375600 and 372000 cubic feet per second, respectively. The outflow through the St. Lawrence River at regulated stage 248·95 would be about 350500 cubic feet per second. With a maximum discharge through the regulating works, there would still have been an excess in supply of 25100 and 21500 cubic feet per second, corresponding to a rise in lake surface of 0·33 foot in April, and 0·28 foot, in May, or a total of 0·61 foot in two months. Hence, if the level of the lake, under regulation, were allowed to fall 0·6 foot, or to 248·35, after the close of the season of navigation, then the plane of regulation of Lake Ontario would probably never be exceeded.

154. Regulating works, designed to discharge about 150000 cubic feet per second, as a minimum, and 350500 cubic feet per second, as a maximum, could be located at the head of the Galop Rapids and would control the monthly mean level of Lake Ontario between 246·95 and 248·95, a range of 2 feet. This scheme of regulation would reduce the fluctuations in lake level from 5½ feet to within 2 feet, and would raise the mean level of Lake Ontario about 2 feet.

155. The effect on the stage of water in the St. Lawrence canals with this scheme of regulation of Lake Ontario would be to cause higher water in the first part and lower water in the last part of the navigation season. Such results would injuriously affect navigation.

COMPENSATING WORKS IN THE NIAGARA RIVER.

156. Your committee had hoped to present a discussion of a project for compensating Lake Erie for the loss of level due to diversions, by works placed above the rapids approaching Niagara Falls. A preliminary examination, however, revealed a lack of data, which prevents consideration of the question at this time.

E. E. HASKELL,
Member, American Section.

LOUIS COSTE,
Member, Canadian Section.

Attest:

W. EDWARD WILSON, C.E.,
Secretary, American Section.

TABLE 2

WATER LEVELS OF LAKE SUPERIOR.

Monthly mean elevations of water surface of Lake Superior, at Superior, Wis., and Marquette, Mich., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
*a*1860	*b*602.69	*b*602.44	*b*602.42	602.69	602.92	603.09	603.05	603.10	603.08	603.12	602.95	*b*602.60	602.85
a 61	*b* 2.40	2.15	2.01	2.42	3.05	3.20	3.36	3.32	3.23	3.26	2.92	2.54	2.82
a 62	2.19	2.00	2.03	2.09	2.77	2.76	2.73	2.90	3.02	2.95	2.62	2.35	2.53
a 63	2.16	2.03	1.86	1.90	2.03	1.95	2.09	2.71	2.73	2.56	2.21	2.10	2.19
a 64	1.81	1.60	1.67	1.69	1.85	2.00	2.09	2.10	2.25	1.99	1.80	1.65	1.88
a 65	1.47	1.46	1.33	1.77	2.26	2.67	2.99	3.07	3.08	2.87	2.34	2.03	2.28
a 66	1.74	1.53	1.53	1.98	2.23	2.42	2.71	2.94	2.67	2.69	2.36	2.47	2.27
a 67	2.20	2.09	1.90	2.12	2.12	2.72	2.12	2.93	3.01	2.99	2.56	2.24	2.49
a 68	2.08	1.49	1.85	2.04	2.44	2.35	2.57	2.49	2.62	2.59	2.75	2.32	2.30
a 69	2.10	1.86	1.41	1.99	2.39	2.40	2.77	3.23	4.08	3.56	3.22	2.57	2.63
*a*1870	2.32	2.11	2.12	2.22	2.55	2.36	2.55	2.55	2.72	2.56	2.38	1.45	2.32
a 71	1.36	0.76	1.18	1.68	2.21	2.33	2.40	2.46	2.56	2.49	2.42	1.68	1.96
72	1.47	1.36	1.24	1.14	1.79	2.17	2.44	2.61	2.77	2.67	2.52	2.22	2.03
73	2.12	*c* 1.80	*c* 1.82	*c* 1.86	2.31	2.61	2.90	3.08	3.14	3.04	2.90	2.60	2.52
74	*c* 2.14	2.13	2.09	2.19	2.26	2.46	2.84	2.93	3.03	3.09	2.91	2.60	2.56
75	2.28	2.24	2.28	2.28	2.50	2.86	2.85	2.94	3.17	3.02	2.88	2.68	2.66
76	2.48	2.27	2.18	2.21	2.75	3.43	3.82	3.93	3.82	3.49	3.33	3.05	3.06
77	2.69	2.45	2.19	2.11	2.10	2.32	2.70	2.76	2.60	2.60	2.39	2.32	2.44
78	2.20	2.32	1.55	1.52	1.79	2.07	2.14	2.02	1.85	1.92	1.72	1.40	1.88
79	*c* 1.49	1.46	1.76	1.37	1.01	1.24	1.48	1.60	1.49	1.58	1.50	*c* 1.14	1.43
1880	*c* 0.99	*c* 0.98	*c* 0.89	*c* 1.92	*c* 1.52	2.30	2.45	2.44	2.44	2.39	2.33	2.07	1.89
81	1.81	1.71	1.62	1.53	1.83	2.27	2.33	2.38	2.61	2.95	2.88	2.60	2.21
82	2.25	2.00	1.89	1.81	1.97	1.99	2.44	2.56	2.60	2.43	2.41	2.22	2.21
83	1.99	1.70	1.70	1.95	1.96	2.06	2.31	2.33	2.29	2.09	1.94	1.83	2.01
84	*c* 1.80	*c* 1.63	*c* 1.54	1.32	1.54	1.74	1.88	1.89	2.16	2.52	2.42	2.21	1.89
85	1.98	1.80	1.72	1.67	2.00	2.28	2.52	2.64	2.57	2.40	2.25	1.92	2.15
86	1.72	1.59	1.53	1.62	1.87	2.01	2.08	1.99	1.97	2.07	1.92	1.78	1.85
87	1.47	1.49	1.80	1.97	1.76	1.92	2.20	2.28	2.14	2.07	1.83	1.61	1.88
88	1.50	1.51	1.44	1.44	1.91	2.69	2.88	3.02	2.97	2.88	2.74	2.39	2.28
89	2.07	1.85	1.68	1.69	2.04	2.16	2.35	2.54	2.67	2.51	2.20	1.90	2.14
1890	1.76	1.63	1.39	1.36	1.57	2.02	2.32	2.47	2.60	2.57	2.36	2.00	2.00
91	1.64	1.51	1.47	1.43	1.63	1.68	1.88	*d* 1.86	*d* 1.82	*d* 1.91	*d* 1.79	1.42	1.67
92	1.42	1.14	1.01	1.02	1.35	1.73	1.76	1.88	1.93	1.83	1.66	1.38	1.51
93	1.10	1.01	1.06	1.16	1.66	2.18	2.48	2.54	2.45	2.42	2.26	2.03	1.86
94	1.85	1.67	1.76	1.91	2.69	2.91	2.97	3.10	3.02	3.04	2.99	2.80	2.56
95	2.50	2.28	2.11	2.01	2.38	2.70	2.90	2.95	3.09	3.14	2.85	2.52	2.62
96	2.32	2.12	1.92	2.01	2.66	3.04	3.10	3.12	2.95	2.63	2.70	2.55	2.59
97	2.39	2.16	2.08	2.11	2.45	2.78	3.08	3.20	3.14	2.94	2.64	2.21	2.60
98	1.83	1.65	1.46	1.46	1.70	2.18	2.59	2.72	2.82	2.76	2.56	2.33	2.17
99	1.96	1.76	1.79	1.76	2.47	2.96	3.19	3.35	3.51	3.32	3.21	3.00	2.69
1900	2.63	2.45	2.23	2.13	2.30	2.36	2.58	2.94	3.46	3.54	3.51	3.13	2.77
01	2.78	2.48	2.28	2.22	2.51	2.61	3.09	3.22	3.04	3.07	3.00	2.68	2.75
02	2.32	2.11	1.97	2.02	2.33	2.64	2.88	2.93	2.81	2.81	*c* 2.81	*e* 2.58	2.52
e 03	2.24	1.98	1.88	2.07	2.56	2.94	3.14	3.25	3.27	3.40	3.18	2.80	2.73
e 04	2.50	2.33	2.23	2.17	2.47	2.77	2.86	2.95	3.08	3.26	3.19	2.74	2.71
e 05	2.47	2.13	2.04	2.25	2.49	2.67	2.97	3.10	3.32	3.33	3.17	2.96	2.74
e 06	2.72	2.43	2.22	2.15	2.48	2.78	2.90	2.93	2.95	2.84	2.66	2.45	2.63
e 07	2.22	2.06	1.94	1.94	2.10	2.55	2.70	2.93	3.17	3.15	2.88	2.53	2.51
Mean	602.03	601.85	601.77	601.86	602.16	602.42	602.63	602.73	602.79	602.74	602.56	602.26	602.32

Authority, U. S. Lake Survey, except for supplied values.

a.—Gauge readings taken at Superior, Wis.

b.—Supplied by applying to the main reading, for the following or preceding month, the mean rise or fall in stage between such months for the years 1861 or 1862 to 1871 inclusive.

c.—Supplied by adding to the Sault Ste. Marie readings the mean fall in the water surface between Marquette and Sault Ste. Marie for the years 1871 to 1888 inclusive.

d.—Supplied in like manner from years 1889 to 1901 inclusive.

e.—From self-registering gauge.

NOTE.—Elevations depend on zero of gauge 601·75 ft. and B.M. 3,609·91 ft., U. S. Lake Survey, 1903 Levels.

TABLE 3.

WATER LEVELS OF ST. MARYS RIVER.

Monthly mean elevations of water surface of St. Marys River, at Southwest pier (above the locks), Sault St. Marie, Mich., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
*a*1860	602.22	601.95	601.93	602.18	602.55	602.74	602.74	602.80	602.72	602.76	602.58	602.18	602.45
a 61	1.93	1.66	1.52	1.91	2.68	2.85	3.05	3.02	2.87	2.90	2.55	2.12	2.42
a 62	1.72	1.51	1.54	1.58	2.40	2.41	2.42	2.60	2.66	2.59	2.25	1.93	2.13
a 63	1.69	1.54	1.37	1.39	1.66	1.60	1.78	2.41	2.37	2.20	1.84	1.68	1.79
a 64	1.34	1.11	1.18	1.18	1.48	1.65	1.78	1.80	1.89	1.63	1.43	1.23	1.48
a 65	1.00	0.97	0.84	1.26	1.89	2.32	2.68	2.77	2.72	2.51	1.97	1.61	1.88
a 66	1.27	1.04	1.04	1.47	1.86	2.07	2.40	2.64	2.31	2.33	1.99	2.05	1.87
a 67	1.73	1.60	1.41	1.61	1.75	2.37	2.74	2.63	2.65	2.63	2.19	1.82	2.09
a 68	1.61	1.00	1.36	1.53	2.07	2.00	2.26	2.19	2.26	2.23	2.38	1.90	1.90
a 69	1.63	1.37	0.92	1.48	2.02	2.05	2.46	2.93	3.72	3.20	2.85	2.15	2.23
1870	*a* 1.85	*a* 1.62	*a* 1.63	*a* 1.71	*a* 2.18	*a* 2.01	*a* 2.24	*a* 2.25	*a* 2.36	*a* 2.20	*a* 2.01	1.03	1.92
71	1.36	1.20	0.93	1.07	1.64	2.05	2.23	2.15	2.20	2.00	1.78	1.39	1.67
72	1.14	1.06	0.82	0.78	1.67	1.84	2.24	2.56	2.63	2.48	2.33	1.88	1.79
73	1.48	1.31	1.33	1.35	1.91	2.04	2.48	2.73	2.80	2.68	2.46	2.22	2.07
74	1.67	1.51	1.40	1.28	1.70	2.13	2.50	2.56	2.54	2.67	2.45	2.35	2.06
75	1.89	1.64	1.60	1.85	2.16	2.46	2.54	2.56	2.84	2.71	2.43	1.87	2.21
76	1.84	1.79	1.53	1.57	2.29	2.87	3.34	3.39	3.42	3.09	2.81	2.32	2.52
77	2.03	2.06	1.94	1.82	1.82	2.04	2.37	2.49	2.25	2.29	2.05	1.89	2.09
78	1.67	1.41	1.31	1.29	1.57	1.83	1.94	1.90	1.61	1.72	1.64	1.42	1.61
79	1.02	0.62	0.38	0.51	0.88	1.02	1.32	1.35	1.27	1.30	1.12	0.72	0.96
1880	0.52	0.49	0.40	0.41	1.15	1.91	2.15	2.03	2.19	1.96	1.99	1.71	1.41
81	1.40	1.30	1.32	1.21	1.63	1.86	2.06	1.98	2.17	2.63	2.53	2.20	1.86
82	1.69	1.47	1.35	1.30	1.71	1.80	2.15	2.25	2.19	2.10	2.04	1.77	1.82
83	1.34	1.25	1.25	1.32	1.31	1.68	1.86	2.28	1.95	1.80	1.69	1.43	1.60
84	1.33	1.14	1.05	0.88	1.25	1.35	1.57	1.61	1.68	1.77	1.87	1.61	1.43
85	1.44	1.33	1.19	1.02	1.60	1.94	2.12	2.34	2.10	1.92	1.85	1.55	1.70
86	1.20	1.04	1.04	1.02	1.50	1.66	1.83	1.97	1.83	1.86	1.79	1.36	1.51
87	1.14	1.00	0.97	0.83	1.19	1.64	2.01	1.89	1.75	1.93	1.70	1.29	1.44
88	1.13	0.79	0.84	0.83	1.43	2.28	2.44	2.43	2.35	2.34	2.14	1.80	1.73
89	1.52	1.23	1.26	1.25	1.81	1.99	2.26	2.27	2.26	2.11	1.81	1.43	1.77
1890	1.48	0.93	0.92	0.85	1.32	1.90	2.26	2.17	2.06	1.99	1.85	1.55	1.61
91	0.86	0.97	0.82	1.00	1.43	1.38	1.49	1.50	1.43	1.49	1.38	1 07	1.24
92	1.01	0.65	0.74	0.63	1.14	1.50	1.64	1.65	1.71	1.60	1.32	1 04	1.20
93	0.79	0.59	0.60	0.85	1.42	1.95	2.15	2.23	2.10	2.04	1.99	1.45	1.51
94	1.23	1.15	1.04	1.42	2.40	2.74	2.78	2.79	2.66	2.70	2.60	2.30	2.14
95	2.00	1.86	1.66	1.64	2.04	2.43	2.67	2.68	2.85	2.97	2.45	2.24	2.29
96	1.69	1.68	1.48	1.57	2.18	2.59	2.72	2.74	2.61	2.18	2.21	2.15	2.15
97	1.92	1.61	1.63	1.76	2.11	2.47	2.69	2.85	2.68	2.47	1.87	1.87	2.20
98	1.38	1.15	1.00	1.13	1.42	1.83	2.17	2.28	2.42	2.26	2.09	2.01	1.76
99	1.53	1.37	1.26	1.26	2.12	2.56	2.76	2.91	3.10	2.77	*b* 2.69	*b* 2.64	2.25
*b*1900	2.03	1.90	1.64	1.68	1.87	1.94	2.17	2.39	2.90	2·93	3.04	2.63	2.26
b 01	2.17	1.87	1.65	1.76	2.06	2.14	2.56	2.74	2.60	2.72	2.66	2.27	2.27
b 02	1.90	1.61	1.53	1.69	1.88	2.24	2.48	2.29	2.54	2.39	2.46	2.29	2.13
b 03	1.83	1.06	1.51	1.76	2.15	2.54	2.70	2.80	2.82	2.98	2.85	2.41	2.33
b 04	1.87	1.64	1.40	1.76	2.09	2.34	2.48	2.55	2.65	2.82	2.71	2.30	2.22
b 05	2.00	1.59	1.36	1.78	2.07	2.25	2.60	2.73	2.92	2.96	2.73	2.52	2.29
b 06	2.18	1.85	1.63	1.70	2.02	2.30	2.50	2.46	2.46	2.36	2.19	1.95	2.13
b 07	1.62	1.43	1.34	1.59	1.71	2.12	2.33	2.50	2.70	2.71	2.56	2.08	2.06
Mea	601.55	601.34	601.24	601.35	601.80	602.08	602.31	602 40	602.41	602.35	602.18	601.86	601.91

Author—U. S. Lake Survey, except for supplied values.

a.—Values supplied by subtracting from the Superior, Wis., readings the full mean in water surface between Superior and Sault Ste. Marie for the years 1860 to November, 1870, inclusive,

b.—From self-registering gauge.

NOTE.—Elevations depend on B. M. "A" 606,069 ft., U. S. Lake Survey, 1903 Levels.

TABLE 4.

WATER LEVELS OF LAKE MICHIGAN.

Monthly mean elevations of water surface of Lake Michigan, at Milwaukee, Wis., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1860	582·51	582·69	582·72	582·85	582·97	583·09	583·13	582·94	582·74	582·34	582·10	581·94	582·68
61	1·83	1·92	2·31	2·41	2·83	2·99	3·12	3·36	3·05	2·93	2·70	2·53	2·66
62	2·33	2·18	2·48	2·64	2·89	3·02	2·92	2·91	2·84	2·73	2·34	2·20	2·62
63	2·13	2·18	2·17	2·17	2·38	2·47	2·42	2·29	2·11	2·02	1·58	1·92	2·15
64	1·69	1·55	1·80	1·51	2·02	2·01	1·91	1·73	1·46	1·07	0·90	0·77	1·54
65	0·56	0·65	0·82	1·31	1·47	1·51	1·94	1·96	1·84	1·60	1·04	0·73	1·29
66	0·47	0·23	0·28	0·73	0·91	1·20	1·46	1·52	1·37	1·26	1·17	0·91	0·96
67	0·89	0·94	1·12	1·41	1·63	1·94	2·09	2·02	1·75	1·42	0·96	0·61	1·40
68	0·45	0·41	1·09	0·99	1·27	1·48	1·51	1·17	0·93	0·70	0·63	0·35	0·92
69	0·25	0·32	0·06	0·43	0·76	1·29	1·67	1·93	1·82	1·46	1·34	1·06	1·03
1870	1,12	1·21	1·51	1·93	2·27	2·41	2·52	2·43	2·57	2·17	1·77	1·42	1·94
71	1·57	1·49	2·09	2·29	2·64	2·68	2·71	2·48	1·81	1·12	1·07	0·48	1·87
72	0·35	0·35	0·13	0·38	0·63	1·00	1·03	1·01	0·94	0·82	0·53	579·87	0·59
73	579·87	579·91	0·22	0·79	1·35	1·98	1·94	2·04	1·85	1·79	1·56	581·52	1·24
74	581·48	581·77	1·92	1·82	1·80	2·17	2·10	2·11	1·86	1·51	1·31	0·97	1·74
75	0·77	0·70	0·76	1·12	1·68	1·92	1·89	2·06	1·99	1·84	1·63	1·44	1·48
76	1·39	1·59	1·92	2·12	2·74	3·15	3·49	3·42	3·37	2·79	2·89	2·42	2·61
77	2·28	2·29	2·29	2·67	2·56	2·63	2·60	2·48	2·27	2·28	2·16	2·10	2,38
78	1·98	1·91	2·07	2·09	2·39	2·53	2·54	2·22	2·02	1·91	1·78	1·46	2·08
79	1·15	1·16	1·20	1·19	1·32	1·39	1·48	1·29	1·17	0·95	0·73	0·76	1·15
1880	0·80	0·71	0·75	0·92	1·26	1·77	1·99	2·02	1·72	1·38	1·06	0·89	1·27
81	0·90	1·11	1·40	1·31	1·82	2·05	2·02	2·02	1·79	2·12	1·95	1·85	1·70
82	1·63	1·62	1·99	2·12	2·22	2·49	2·62	2·81	2·69	2·28	2·07	1·74	2·19
83	1·48	1·52	1·61	1·82	2·30	2·66	3·26	3·23	3·04	2·82	2·37	2·29	2·37
84	2·07	2·19	2·44	2·62	2·83	2·99	2·88	2·69	2·44	2·44	2·08	2·05	2·47
85	2·06	2·29	2·25	2·44	2·80	3·01	3·10	3·31	3·17	3·03	2·73	2·44	2·72
86	2·67	2·69	2·97	3·24	3·50	3·57	3·38	3·15	2·91	2·81	2·47	2·14	2·96
87	2·06	2·43	2·59	2·54	2·74	2·87	2·81	2·67	2·33	1·88	1·55	1·43	2·32
88	1·25	1·20	1·38	1·59	1·97	2·24	2·25	2·13	1·98	1·73	1·68	1·10	1·71
89	1·08	1·05	1·03	1·04	1·12	1·58	1·76	1·52	1·35	1·10	0·75	0·57	1·16
1890	0·65	0·61	0·59	0·91	1·14	1·55	1·62	1·54	1·34	1·23	0·89	0·54	1·05
91	0·52	0·28	0·47	0·78	0·88	1·03	0·86	0·79	0·56	0·20	579·80	579·74	0·49
92	579·86	0·05	579·95	0·01	0·43	0·88	0·89	0·97	0·77	0·53	580·26	9·99	0·38
93	9·98	0·12	580·23	0·69	0·99	1·32	1·34	1·17	0·85	0·71	0·32	580·25	0·66
94	580,26	0·29	0·55	0·70	1·24	1·40	1·43	1·35	0·92	0·71	0·44	- 0·09	0·78
95	579·91	579·80	579·77	579·97	0·13	0·18	0·07	579·95	579·68	579·31	579·09	578·98	579·74
96	9·06	9·10	9·11	9·29	579·57	579·89	579·83	9·76	9·66	9·61	9·39	9·34	9·47
97	9·33	9·41	9·72	9·89	580·38	580·65	580·84	580·78	580·53	580·24	9·98	9·76	580·13
98	9·72	9·86	580·18	580·50	0·78	0·91	0·89	0·69	0·34	0·33	9·92	9·58	0·31
99	9·53	9·61	579·81	0·08	0·52	0·83	1·04	0·96	0·82	0·49	580·31	9·81	0·32
1900	9·66	9·77	9·94	0·07	0·31	0·42	0·53	0·70	0·65	0·66	0·52	580·19	0·28
01	9·95	9·92	580·34	0·49	0·92	0·97	1·06	1·11	0·92	0·56	0·23	579·95	0·54
02	9·76	9·61	579·84	579·91	0·30	0·50	0·83	0·85	0·48	0·33	0·20	9·91	0·22
03	9·69	9·85	580·06	580·33	0·43	0·61	0·79	0·72	0·77	a 0·50	a 0·14	a 9·88	0·31
a 04	9·90	9·86	0·14	0·60	0·95	1·35	1·36	1·26	1·19	1·06	0·75	580·44	0·74
a 05	580·27	580·21	0·33	0·71	0·97	1·36	1·54	1·51	1·41	0·97	0·71	0·55	0·88
06	a 0·53	a 0·68	a 0·83	a 1·01	1·27	1·39	1·44	1·41	1·06	0·86	0·68	0·69	0·99
07	0·60	0·64	0·70	0·96	1·12	1·48	1·48	1·38	1·37	1·16	0·74	0·63	1·02
Mean	580·84	580·87	581·04	581·24	581·53	581·77	581·84	581·79	581·59	581·37	581·11	580·88	581·32

Authority, U. S. Lake Survey.

a.—Self-registering gauge on harbour pier.

NOTE.—Elevations depend on check point (1876) on Chestnut St. Bridge (destroyed) as 586·55 ft. and check point (1902) on same bridge as 584·47 ft. , U.S. Lake Survey, 1903, Levels.

TABLE 5.

WATER LEVELS OF LAKE HURON.

Monthly mean elevations of water surface of Lake Huron, at Harbor Beach, Mich., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1860	582·83	582·78	582·92	582·89	582·94	583·18	583·27	583·19	583·00	582·62	582·50	582·20	582·86
61	1·99	2·03	2·17	2·37	2·99	3·33	3·45	3·56	3·48	3·26	2·95	2·82	2·87
62	2·44	2·43	2·34	2·55	2·92	3·04	3·09	3·07	2·85	3·13	2·81	2·52	2·77
63	2·36	2·21	2·16	2·23	2·55	2·68	2·59	2·60	2·46	2·20	2·16	1·93	2·34
64	1·79	1·75	1·75	1·95	2·38	2·39	2·34	2·23	1·91	1·38	1·21	1·08	1·85
65	0·72	0·81	0·98	1·47	1·63	1·67	2·10	2·12	2·00	1·76	1·20	·089	1·45
66	0·63	0·39	0·44	0·88	1·07	1·36	1·62	1·68	1·53	1·42	1·33	1·07	1·12
67	1·05	1·10	1·28	1·57	1·79	2·10	2·25	2·18	1·91	1·58	1·12	0·77	1·56
68	0·61	0·57	1·25	1·15	1·43	1·64	1·67	1·33	1·09	0·86	0·79	0·51	1·08
69	0·41	0·48	0·22	0·59	0·92	1·45	1·83	2·09	1·98	1·62	1·50	1·22	1·19
1870	1·28	1·37	1·67	2·09	2·43	2·57	2·68	2·59	2·73	2·33	1·93	1·58	2·10
71	1·73	1·65	2·25	2·45	2·80	2·84	2·87	2·56	2·24	1·74	1·53	1·16	2·15
72	0·99	0·79	0·29	0·71	1·11	1·51	1·61	1·58	1·48	1·36	1·06	0·77	1·10
73	0·60	0·57	0·64	1·05	1·55	1·95	2·15	2·16	1·99	1·96	1·86	1·70	1·52
74	1·72	1·86	2·00	1·85	1·90	2·24	2·40	2·29	2·11	1·84	1·30	1·45	1·91
75	1·16	1·10	1·14	1·33	1·68	1·99	2·18	2·15	2·19	2·00	1·89	1·62	1·70
76	1·74	1·72	1·85	2·13	2·73	3·22	3·66	3·60	3·49	3·09	2·94	2·75	2·74
77	2·46	2·45	2·38	2·46	2·63	2·59	2·77	2·67	2·40	2·26	2·21	2·16	2·45
78	2·06	1·89	2·06	1·99	2·39	2·56	2·60	2·50	2·21	2·22	2·03	1·83	2·20
79	1·53	1·29	1·25	1·28	1·41	1·55	1·59	1·46	1·38	1·14	1·02	1·00	1·32
1880	1·05	0·99	0·98	0·99	1·39	1·88	2·19	2·08	1·97	1·71	1·49	1·29	1·49
81	1·16	1·55	1·56	1·58	1·90	2·07	2·22	2·05	1·89	2·14	2·27	2·10	1·87
82	1·95	1·72	1·86	2·08	2·25	2·48	2·62	2·68	2·56	2·33	2·08	1·93	2·21
83	1·73	1·68	1·72	1·73	2·30	2·72	3·20	3·40	3·08	2·75	2·86	2·75	2·49
84	2·56	2·41	2·45	2·76	2·98	3·04	3·12	3·00	2·65	2·81	2·46	2·20	2·70
85	2·47	2·38	2·38	2·49	2·89	3·18	3·24	3·39	3·29	3·06	2·87	2·67	2·86
86	2·67	2·74	2·93	3·22	3·55	3·64	3·48	3·33	3·15	3·02	2·75	2·43	3·08
87	2·26	2·45	2·66	2·57	2·77	2·89	2·97	2·76	2·41	2·19	1·74	1·45	2·43
88	1·34	1·25	1·42	1·56	2·00	2·30	2·33	2·37	2·08	1·78	1·60	1·39	1·78
89	1·25	1·17	1·15	1·08	1·22	1·55	1·81	1·75	1·58	1·21	0·87	0·71	1·28
1890	0·78	0·66	0·64	0·78	1·09	1·52	1·71	1·71	1·44	1·23	1·03	0·73	1·11
91	0·53	0·42	0·39	0·72	0·96	0·91	0·94	0·84	0·65	0·28	579·97	579·91	0·54
92	579·93	579·87	579·93	0·05	0·14	0·67	0·96	1·04	0·87	0·66	580·33	580·09	0·38
93	9·84	9·79	9·87	0·25	0·88	1·21	1·35	1·21	0·91	0·73	0·47	0·28	0·57
94	580·23	580·24	580·39	0·62	1·02	1·32	1·47	1·20	1·01	0·77	0·58	0·28	0·76
95	579·96	579·84	579·85	579·95	0·12	0·19	· 0·16	0·07	579·94	579·65	579·26	579·02	579·83
96	9·09	9·21	9·11	9·14	579·54	579·91	579·97	0·01	9·83	9·63	9·49	9·38	9·53
97	9·45	9·36	9·47	9·84	580·41	580·65	580·83	0·84	580·58	580·23	580·07	9·81	580·13
98	9·66	9·72	9·95	580·44	0·56	0·72	0·82	0·71	0'52	0·21	0·13	9·94	0·28
99	9·68	9·54	9·69	579·86	0·40	0·79	1·08	0·99	0·79	0·38	0·24	580·05	0·29
1900	9·82	9·83	9·86	9·98	0·13	0·30	0·55	0·64	0·72	0·66	0·66	0·46	0·30
01	580·22	580·08	580·07	a580·55	a 0·81	a 0·91	a 1·06	a 1·11	a 0·88	a 0·66	a 0·43	a 0·10	0·57
a 02	0·00	579·81	579·73	579·91	0·16	0·48	0·76	0·83	0·51	0·27	0·17	579·93	0·22
a 03	579·74	9,78	9·92	580·27	0·39	0·56	0·75	0·73	0·80	0·83	0·41	580·12	0·36
a 04	9·91	9·91	580·08	0·63	0·96	1·42	1·55	1·53	1·36	1·26	0·95	0·50	0·84
a 05	580·38	580·30	0·29	0·66	0·95	1·40	1·57	1·56	1·45	1·22	0·93	0·67	0·95
a 06	0·53	0·69	0·76	0·94	1·20	1·33	1·45	1·36	1·12	0·87	0·68	0·65	0·96
a 07	0·65	0·68	0·68	0·90	1·08	1·39	1·64	1·49	1·42	1·21	0·83	0·62	1·05
Mean	581·02	580·99	581·06	581·26	581·57	581·82	581·97	581·92	581·75	581·53	581·31	581·09	581·44

Authority, U. S. Lake Survey (see page 4105, appendix EEE. Annual Report of the Chief of Engineers for 1904.)

a.—Self-registering gauge.

NOTE.—Elevations depend on gauge bolt "E" 583·21 ft., B.M."Jenks" 610·56 ft., U.S. Lake Survey, 1903 Levels.

255x51—8,005

TABLE 6.

WATER LEVELS OF ST. CLAIR RIVER.

Monthly mean elevations of water surface of St. Clair River, at Grand Trunk Railway (G. T. R.), in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
*a*1860	582.06	582.02	582.14	581.82	581.86	582.08	582.16	582.08	581.92	581.58	581.47	581.20	581.87
a 61	1.31	1.35	1.47	1.36	1.91	2.21	2.32	2·41	2.34	2.15	1.87	1.76	1.87
a 62	1.71	1.70	1.62	1.52	1.84	1.95	2.00	1.98	1.78	2.03	1.75	1.49	1.78
a 63	1.64	1.51	1.46	1.23	1.52	1.63	1.55	1.56	1.44	1.20	1.17	0.96	1.41
a 64	1.14	1.10	1.10	0.98	1.36	1.37	1.33	1.23	0.95	0.48	0.32	0.21	0.96
a 65	0.18	0.26	0.42	0.56	0.70	0.73	1.12	1.13	1.03	0.81	0.32	0.04	0.61
a 66	0.10	579.89	579.93	0.03	0.20	0.46	0.69	0.74	0.61	0.51	0.43	0.20	0.32
a 67	0.48	580.52	580.68	0.64	0.84	1.12	1.25	1.19	0.95	0.65	0.24	579.93	0.71
a 68	0.09	0.05	0.56	0.27	0.52	0.71	0.73	0.43	0.22	0.01	579.95	9.70	0.27
a 69	579.91	579.97	579.74	579.77	0.07	0.54	0.88	1.11	1.01	0.69	580.58	580.33	0.38
*a*1870	580.68	580.76	581.03	581.11	1.41	1.53	1.63	1.55	1.68	1.32	0.96	0.65	1.19
a 71	1.08	1.01	1.54	1.43	1.74	1.77	1.80	1.52	1.24	0.80	0.61	0.28	1.24
a 72	0.42	0.25	579.80	579.88	0.24	0.59	0.68	0.65	0.56	0.46	0.19	579.93	0.30
a 73	0.08	0.05	580.11	580.18	0.63	0.98	1.16	1.17	1.02	0.99	0.90	580.76	0.67
a 74	1.07	1.20	1.32	0.89	0.94	1.24	1.38	1.28	1.12	0 88	0.40	0.54	1.02
a 75	0.57	0.52	0.56	0.43	0.74	1.02	1.19	1.16	1.20	1.03	0.93	0.69	0.84
a 76	1.09	1.07	1.19	1.14	1.68	2.11	2.50	2.45	2.35	2.00	1.86	1.69	1.76
a 77	1.73	1.72	1.66	1.44	1.59	1.55	1.71	1.62	1.38	1.26	1.21	1.17	1.50
a 78	1.38	1.22	1.38	1.02	1.37	1.52	1.56	1.47	1.21	1.22	1.05	0.88	1.27
a 79	0.90	0.69	0.66	0.39	0.50	0.63	0.66	0.55	0.48	0.26	0.16	0.14	0.50
*a*1880	0.48	0.42	0.42	0.13	0.38	0.92	1.20	1.10	1.00	0.68	0.57	0.40	0.65
a 81	0.58	0.92	0.93	0.65	0.94	1.09	1.22	1.07	0.93	1.15	1.27	1.12	0.99
a 82	1.28	1.07	1.20	1.10	1.25	1.45	1.58	1.63	1.52	1.32	1.10	0.96	1.29
a 83	1.08	1.04	1.07	0.79	1.29	1.67	2.09	2.27	1.99	1.69	1.79	1.69	1.54
a 84	1.82	1 69	1.72	1.70	1.90	1.95	2.02	1.92	1.60	1.75	1.44	1.20	1.73
a 85	1.74	1.66	1.66	1.46	1.82	2.08	2.13	2.26	2.17	1.97	1.80	1.62	1.86
a 86	1.92	1.98	2.15	2.11	2.41	2.49	2.34	2.24	2.05	1.93	1.69	1.41	2.06
a 87	1.55	1.72	1.91	1.53	1.71	1.82	1.89	1.70	1.39	1.20	0.80	0.54	1.48
a 88	0.74	0.66	0.81	0.64	1.03	1.29	1.32	1.36	1.09	0.83	0.67	0.48	0.91
a 89	0.66	0.58	0.57	0.21	0.33	0.63	0.86	0.80	0.55	0.32	0.02	579.88	0.45
*a*1890	0.24	0.13	0.11	579.94	0.22	0.60	0.77	0.77	0.53	0.34	0.16	9.90	0.31
a 91	0.01	579.92	579.89	9.89	0.10	0.06	0.08	0.00	579.83	579.50	579.22	9.17	579.81
a 92	579.48	9.43	9.48	9.26	579.37	579.84	0.10	0.17	580.02	9.84	9.54	9.33	9.66
a 93	9.40	9.36	9.43	9.47	580.03	580.70	0.45	0.32	0.07	9.88	9.68	9.50	9.86
a 94	9.75	9.76	9.89	9.80	0.16	0.42	0.56	0.32	0.15	9.93	9.76	9.50	580.00
a 95	9.57	9.46	9.47	9.27	579.40	579.48	579.45	579.37	579.26	9.00	8.65	8.44	579.24
a 96	8.80	8.90	8.81	8.55	8.90	9.23	9.28	9.32	9.16	8.98	8.86	8.65	8.96
a 97	9.12	9.04	9.16	9.17	9.68	9.89	580.05	580.06	9.83	9.52	9.41	9.14	9.51
a 98	9.30	9.36	9.56	9.70	9.81	9.95	0.04	579.94	9.77	9.50	9.43	9.26	9.64
99	*a* 9.32	*a* 9.20	*b* 9.33	*b* 9.21	*b* 9.58	*b*580.02	*b* 0.30	*b*580.24	*b*580.05	*b* 9.60	*b* 9.47	*b* 9.28	9.63
*b*1900	9.39	9.47	9.47	9.22	9.43	579.58	579.80	579.87	579.85	9.77	9.75	9.52	9.59
b 01	9.57	9.76	9.56	580.02	9.99	9.98	580.17	580.26	580.02	9.79	9.58	9.32	9.84
b 02	9.53	9.34	9.95	579.11	9.32	9.63	579.95	0.01	579.73	9.55	9.35	9.18	9.47
b 03	9.37	9.44	9.28	9.52	9.56	9.77	9.90	579.93	9.96	9.94	9.54	9.41	9.64
b 04	9.46	9.50	9.54	9.90	580.12	580.53	580.56	580.55	580.46	580.32	580.07	9.77	580.06
b 05	580.18	580.07	9.79	9.83	0.07	0.50	0.70	0.70	0.57	0.31	0.04	580.78	0.30
b 06	579.75	0.30	580.23	580.11	0.30	0.38	0.57	0.49	0.27	0.04	579.88	0.07	0.20
b 07	580.13	0.39	0.12	0.08	0.22	0.49	0.66	0.63	0.53	0.33	9.90	579.74	0.27
Mean	580.46	580.45	580.48	580.38	580.65	580.88	581.00	580.97	580.81	580.61	580.41	589.25	580.61

Authority, U. S. Lake Survey, except for supplied values.

a.—Supplied from Harbour Beach readings for the summer months, April to December, inclusive, by formula (G. T. R.—578)=0·889 (Harbour Beach—578)—0·529; and for winter months, January to March, inclusive, by formula (G. T. R.—578)=0·889 (Harbour Beach—578)—0·235.

b.—Self-registering gauge.

NOTE.—Elevations depend on B. M. Fort Gratiot Light-house (1877) as 590·312 ft., U. S. Lake Survey, 1903 Levels.

TABLE 7. WATER LEVELS OF LAKE ST. CLAIR.

Monthly mean elevation of water surface of Lake St. Clair, at the St. Clair Flats Canal, in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
a1860	576.31	574.84	575.94	576.50	576.89	577.03	576.40	576.30	575.90	576.59	575.68	576.29	576.22
b 61	6.37	4.93	6.02	6.77	6.83	7.03	7.00	7.17	6.98	6.78	6.64	6.64	6.60
b 62	6.29	5.14	6.07	7.24	7.24	7.28	7.27	7.15	6.94	6.74	6.43	6.30	6.67
b 63	6.48	6.41	6.15	6.63	6.90	6.77	6.83	6.79	6.61	6.11	5.94	5.90	6.46
b 64	6.14	5.50	5.61	6.30	6.70	6.90	6.67	6.47	6.29	5.80	5.72	5.83	6.16
65	b 4.53	b 3.78	b 4.48	b 5.64	b 6.17	b 6.21	b 6.40	c 6.38	c 6.32	c 6.11	c 5.66	c 5.52	5.60
66	b 5.42	c 4.91	c 4 96	c 5.72	c 5.84	c 6.13	c 6.39	c 6.24	c 6.18	c 6.18	c 6.03	c 6.20	5.85
c 67	5.30	5.28	4.82	6.06	6.46	6.84	6 70	6.61	6.25	5.90	5.42	5.30	5.91
68	d 5.27	d 4 15	d 5.43	c 5.64	c 6.10	c 6.41	c 6.34	c 6.00	c 5.78	c 5.40	c 5 15	c 5.12	5.57
69	d 4.81	d 4.39	d 4.58	c 5.35	c 5.45	c 6.00	c 6.48	c 6.48	c 6.28	c 5.87	c 5 60	d 5 95	5 60
1870	d 6 79	d 5.52	d 5.52	c 6.38	c 6.74	c 6.80	c 7.04	c 6.98	c 6.74	c 6.34	c 6.11	c 6.10	6.42
71	d 5 71	d 4.71	c 6.40	c 6.48	c 6.72	c 6.78	c 6.82	c 6.63	c 6.36	c 5.78	c 5.60	d 5.83	6.15
72	d 5.09	d 4.98	d 4.70	c 5.12	c 5.32	c 5.74	5.47	5.61	5.47	5.45	4.96	4.92	5.24
73	4.42	4.65	4.99	5.87	5.89	6.16	6.30	6.29	6.06	5.81	5.62	5.83	5.66
74	5.05	4.41	5.84	6.06	6.02	6.23	6.40	6.31	6.10	5.86	5.57	5.26	5.76
75	5.11	5 04	5.20	5.21	5.78	5.95	6.18	6.11	5.96	5.79	5.61	5.51	5.62
76	5.66	6.11	6.89	6.86	6.63	7.52	7.68	7.51	7.04	6.71	6.60	7.45	6.89
77	6.98	5.52	4.24	5.20	5.45	6.28	6.53	6.44	6.19	c 6.12	6.24	6.03	5.94
78	5.92	5 00	5.16	b 6.47	b 6.63	6.68	6.80	6.71	6.37	6.18	5.85	5.61	6.12
79	5.20	4.51	5.20	5.75	5.63	b 5.90	b 6.01	b 5.80	b 5.61	b 5.32	b 5.02	b 5.25	5.43
b1880	5.52	5.07	5.50	5.66	5.84	6.23	6.19	6.27	6.02	5.68	5.51	6.18	5.81
81	b 4.60	b 5.05	b 5.06	b 6.01	b 6.01	b 6.31	b 6.32	b 6.20	6.07	e 5.87	e 6.00	e 6.13	5.77
82	e 6.40	e 6.02	e 6.53	c 6.57	6.99	c 6.58	7.41	7.40	e 6.76	c 6.45	6.17	e 6.67	6.68
83	c 6.28	e 6.00	e 5.39	e 5.95	6.34	7.07	7.74	7.66	7.20	6.83	6.39	6.36	6.60
84	4.93	5.38	6.75	6.99	7.16	7.33	7.38	7.09	6.73	6.51	6.14	6.32	6.56
85	6.82	6.02	6.86	6.88	6.73	7.10	7.01	7.12	6.97	6.65	6.61	6.59	6.78
86	5.75	4.86	5.64	6.30	6.99	7.04	7.95	6.93	6.78	6.62	6.28	6.55	6.40
87	6.24	6.35	6.35	6.55	6.77	6.86	6.86	6.68	6.40	6.07	5.65	5.61	6.37
88	5.67	5.45	5.16	5.81	5.83	6.04	6.33	6.23	5.99	5.71	5.58	5.47	5.77
89	5.71	4.77	4.68	4.98	5.36	5.91	6.05	5.90	5.70	5.31	5.03	4.96	5.36
1890	5.44	5.29	5.26	5.65	5 91	6.34	6.27	6.03	5.79	5.57	5.54	5.39	5.71
91	4.97	5.07	4.86	5.23	5 18	5.29	5.36	5.25	5.12	4.80	4.56	4.64	5.03
92	4 26	3.51	3.70	4.53	5.07	5.69	5.89	5.71	5.60	5.15	4.76	4.54	4.87
93	3.70	3.80	4.64	5.07	5.48	5.82	5.86	5.68	5.42	5.16	4.88	4.98	5.04
94	4.99	4.49	4.86	5.01	5.46	5.69	5.73	5.53	5.38	5.12	4.88	4.82	5.16
95	5 28	5.29	4 69	4.19	4.49	4.63	4.69	4.65	4.53	4.13	3.84	4.12	4.54
96	4 17	3.33	3.57	4.09	4 34	4.70	4.87	5.03	4.71	4.61	4.15	4.13	4.31
97	4 42	4.77	4.72	4.77	5 18	5.28	5.43	5.40	5.14	4.78	4.61	4.64	4.93
98	4.58	4.10	4.73	5.17	5.29	5.49	5.54	5.40	5.13	4.87	4.82	4.90	5.00
99	4 80	4.57	4.53	4.65	5.07	5.34	5.51	5.45	5.14	4 84	4.71	4.65	4.94
1900	4.18	4.29	4.77	4.87	4.98	5.15	5.23	5.28	5.16	5.01	4.88	4.74	4.88
01	4.59	3.68	3.96	3.17	4.27	5.03	5.24	5.24	5.22	4.90	4.61	4.64	4.55
02	f 3.70	f 3.29	f 4.26	4.46	4.70	5.07	5.70	5.56	5.28	5.18	4.89	4.99	4.76
03	5.19	f 4.73	f 5.05	f 5.57	5.36	5.49	5.62	5.54	5.53	5.39	4.89	5.29	5.30
04	4.12	4.44	5.58	58.5	5.80	6.13	6.19	6.08	5.92	5.68	5.28	5.39	5.54
05	4 46	4.14	4.75	5.05	5.39	5.82	6.01	5.95	5.78	5.54	5.26	5.11	5.27
06	f 5 25	f 4.32	f 4.30	f 5.14	f 5.40	f 5.61	f 5.81	f 5.76	f 5 55	f 5.37	5.44	4.32	5.27
07	5 49	4.99	5.02	5.64	5.78	6.11	6.27	f 5.98	f 5.76	f 5.69	f 5.35	f 5.32	5.62
Mean	575 30	574.85	575.20	575.64	575.89	576.17	576.28	576.19	575.96	575.72	575.48	575.53	575.68

Authority, U. S. Lake Survey, except for supplied values.

a.—Deduced by subtracting 0·67 foot from St. Clair Flats values (U. S. L. S. Report, 1904) to obtain original values at Old Detroit Waterworks, then supplying by formula (Fall St. Clair Flats to Amherstburg) =0·9378 (Fall Old Detroit Waterworks to Amherstburg +0·853.

b.—suppled by formula (Fall St. Clair Flats to Amherstburg) = 1·0357 (Fall Light-house Depot to Amherstburg) + 0·377.

c.—Supplied by using mean of two values derived from equations (Fall St. Clair Flats to Amherstburg) = 0·9378 (Fall Old Detroit Waterworks to Amherstburg) + 0·853; and (Fall St. Clair Flats to Amherstburg) = 1·0357 (Fall Light-house Depot to Amherstburg) + 0·377.

d.—Supplied by formula (Fall St. Clair Flats to Amherstburg) = 0·9378 (Fall Old Detroit Waterworks to Amherstburg) + 0·853

e.—Derived by first subtracting 0·477 foot from New Detroit Waterworks readings and then applying the mean monthly fall from St. Clair Flats to New Detroit Waterworks, as deduced from observations taken at those points from January, 1899, to June, 1901, inclusive.

f.—Derived from observations taken at Windmill Point by applying the mean monthly fall from St. Clair Flats Canal to Windmill Point, as determined from simultaneous observations taken at those points from January, 1897, to July, 1907, inclusive.

NOTE.—Elevations depend on zero of gauge 575·36 feet, and P.B.M., "Upper Light," 581·76 ft., U.S. Lake Survey, 1903 Levels.

TABLE 8.

WATER LEVELS OF LAKE ST. CLAIR.

Monthly mean elevations of water surface of Lake St. Clair, at Windmill Point, near the outlet of Lake St. Clair, in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
*a*1860	575·92	574·51	575·64	576·24	576·69	576·84	576·17	576·08	575·655	576·30	575·38	575·93	575·95
a 61	5·98	4·60	5·72	6·51	6·63	6·84	6·77	6·95	6·73	6·49	6·34	6·28	6·32
a 62	5·90	4·81	5·77	6·98	7·04	7·09	7·04	6·93	6·69	6·45	6·13	5·94	6·40
r 63	6·09	6·08	5·85	6·37	6·70	6·58	6·60	6·57	6·36	5·82	5·64	5·54	6·18
r 64	5·75	5·17	5·31	6·04	6·50	6·71	6·44	6·25	6·04	5·51	5·42	5·47	5·88
a 65	4·14	3·45	4·18	5·38	5·97	6·02	6·17	6·16	6·07	5·82	5·36	5·16	5·32
a 66	5·03	4·58	4·66	5·46	5·65	5·94	6·16	6·02	5·93	5·89	5^{3}73	5·84	5·57
a 67	4·91	4·95	4·52	5·80	6·26	6·65	6·47	6·39	6·00	5·61	5·12	4·94	5·64
a 68	4·88	3·82	5·13	5·38	5·90	6·22	6·11	5·78	5·53	5·11	4·85	4·76	5·29
a 69	4·42	4·06	4·28	5·09	5·25	5·81	6·25	6·26	6·03	5·58	5·30	5·59	5·33
*a*1870	6·40	5·19	5·22	6·12	6·54	6·61	6·81	6·76	6·49	6·05	5·81	5·74	6·14
a 71	5·32	4·38	6·10	6·22	6·52	6·59	6·59	6·41	6·11	5·49	5·30	5·47	5·88
a 72	4·70	4·65	4·40	4·84	5·12	5·55	5·24	5·39	5·22	5·16	4·66	4·56	4·96
a 73	4·03	4·32	4·69	5·61	5·69	5·97	6·07	6·07	5·81	5·52	5·32	5·47	5·38
a 74	4·66	4·08	5·54	5·80	5·82	6·04	6·17	6·09	5·85	5·57	5·27	4·90	5·48
a 75	4·72	4·71	4·90	4·95	5·58	5·76	5·95	5·89	5·71	5·50	5·31	5·15	5·34
a 76	5·27	5·78	6·59	6·60	6·43	7·33	7·45	7·29	6·79	6·42	6·30	7·09	6·61
a 77	6·59	5·19	3·94	4·94	5·25	6·09	6·30	6·22	5·94	5·83	5·94	5·67	5·66
a 78	5·53	4·67	4·86	6·21	6·43	6·49	6·57	6·49	6·12	5·89	5·55	5·25	5·84
a 79	4·81	4·18	4·90	5·49	5·43	5·71	5·78	5·58	5·36	5·03	4·72	4·89	5·16
*a*1880	5·13	4·74	5·20	5·40	5·64	6·04	5·96	6·05	5·77	5·39	5·21	5·82	5·53
a 81	4·21	4·72	4·76	5·41	5·81	6·12	6·09	5·98	5·82	5·58	5·70	5·77	5·50
a 82	6·01	5·69	6·23	6·31	6·79	6·62	7·18	7·18	6·51	6·16	5·87	6·31	6·40
a 83	5·89	5·67	5·09	5·69	6·14	6·88	7·51	7·44	6·95	6·54	6·09	6·00	6·32
a 84	4·54	5·05	6·45	6·73	6·96	7·14	7·15	6·87	6·48	6·22	5·84	5·96	6·28
a 85	6·43	5·69	6·56	6·62	6·53	6·91	6·78	6·90	6·72	6·36	6·31	6·23	6·50
a 86	5·36	4·53	5·34	6·04	6·79	6·85	6·82	6·71	6·53	6·33	5·98	6·19	6·12
a 87	5·85	6·02	6·05	6·29	6·57	6·67	6·63	6·46	6·15	5·78	5·35	5·25	6·09
a 88	5·28	5·12	4·86	5·55	5·63	5·85	6·10	6·01	5·74	5·42	5·28	5·11	5·50
a 89	5·32	4·44	4·38	4·72	6·15	5·72	5·82	5·68	5·45	5·02	4·73	4·60	5·09
*a*1890	5·05	4·96	4·96	5·39	5·71	5·16	6·04	5·81	5·54	5·28	5·24	5·03	5·43
a 91	4·58	4·74	4·56	4·97	4·98	5·10	5·13	5·03	4·87	4·51	4·26	4·28	4·75
a 92	3·87	3·18	3·40	4·27	4·87	5·50	5·66	5·49	5·35	4·86	4^{3}46	4·18	4·59
a 93	3·31	3·47	4·34	4·81	5·28	5·63	5·63	5·46	5·17	4·87	4·58	4·62	4·76
a 94	4·60	4·16	4·56	4·75	5·26	5·50	5·50	5·31	5·13	4·83	4·58	4·46	4·89
a 95	4·89	4·96	4·39	3·93	4·29	4·44	4·46	4·43	4·28	3·84	3·54	3·76	4·27
a 96	3·78	3·00	3·27	3·83	4·14	4·51	4·64	4·81	4·46	4·32	3·85	3·77	4·03
97	4·28	4·64	4·57	4·75	5·20	5·11	5·22	5·15	4·93	4·58	4·47	4·29	4·77
98	4·20 *a*	3·77	4·76	5·01	5·11	5·26	5·30	5·10	4·90	4·64	4·65	4·68	4·78
99	4·65	4·57	3·59	4·32	4·88	5·18	5·30	5·22	4·93	4·65	4·49	4·10	4·66
1900	4·03	4·24	4·67	4·64	4·79	4·99	5·01	5·06	4·89	4·74	4·52	4·41	4·67
01	4·01	3·06	3·32	2·69	3·94	4·81	5·04	5·07	4·89	4·56	4·30	4·47	4·18
02	3·31	2·96	3·96	4·22 *a*	4·50 *a*	4·88	5·50	5·41	5·08	4·92	4·62	4·64	4·50
03	4·69	4·40	4·75	5·31	5·27	5·38	5·44	5·36	5·29	5·04	4·54	4·94	5·03
04	3·74	3·92	4·92	5·64	5·61	5·92	5·97	5·82	5·60	5·31	4·94	4·89	5·19
05	3·78	3·50	3·87	4·73	5·11	5·66	5·80	5·74	5·52	5·18	4·84	4·73	4·87
06	4·86	3·99	4·00	4·88	5·20	5·42	5·58	5·54	5·30	5·08	4·99	4·89	4·98
07	4·94	4·65	4·60	5·24	5·44	5·78	5·90	5·76	5·51	5·40	5·05	4·96	5·27
Mean	574·91	574·52	574·87	575·38	575·69	575·98	576·05	575·97	575·71	575·43	575·16	575·17	575·40

Authority ,U.S. Lake Survey, except for supplied values.

a.—Supplied by applying to the St. Clair Flats readings, the mean monthly fall from St. Clair Flats to Windmill Point, as deduced from observations taken between the years 1897 and 1907, inclusive.

NOTE.—Elevations depend on P. B. M., 12, 584·22 ft., U. S. Lake Survey, 1903 Levels.

TABLE 9.

WATER LEVELS OF DETROIT RIVER.

Monthly mean elevations of water surface of Detroit River, at Amherstburg, Ont., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
a1860	573·48	573·12	573·54	574·19	574·49	574·45	574·20	574·08	573·68	573·37	573·15	573·11	573·74
a 61	2·83	2·55	3·01	4·00	4·52	4·58	4·34	4·42	4·18	3·94	3·79	3·68	3·82
a 62	3·65	3·36	3·52	4·37	4·70	4·69	4·67	4·33	3·96	3·57	3·10	3·25	3·93
a 63	3·68	3·97	3·93	4·00	4·27	4·12	4·01	3·97	3·52	3·07	2·53	2·62	3·64
a 64	2·31	2·46	2·69	3·14	3·93	3·87	3·62	3·39	3·11	2·79	2·49	2·68	3·04
a 65	2·23	1·65	1·99	2·66	3·33	3·30	3·27	3·23	3·13	2·82	2·31	2·29	2·68
a 66	2·00	1·84	2·25	2·78	3·09	3·34	3·46	3·25	3·13	3·11	2·74	2·87	2·82
a 67	2·56	2·24	2·66	2·93	3·54	3·84	3·66	3·39	2·94	2·59	1·96	1·86	2·85
a 68	1·64	1·26	1·87	2·65	3·19	3·57	3·55	3·07	2·74	2·28	1·99	1·90	2·48
a 69	1·87	1·80	2·30	2·55	3·19	3·57	3·86	3·80	3·47	3·01	2·42	2·89	2·89
a1870	3·11	3·34	3·13	3·73	4·03	3·99	4·04	4·03	3·72	3·33	2·90	2·90	3·52
a 71	2·67	2·34	2·81	3·24	3·60	3·62	3·61	3·44	3·21	2·53	2·22	1·90	2·93
a 72	1·80	1·56	1·49	1·64	2·17	2·53	2·53	2·54	2·25	2·07	1·61	1·50	1·97
a 73	1·38	1·39	1·48	2·71	3·47	3·54	3·53	3·51	3·05	2·74	2·41	2·90	2·68
a 74	3·27	3·32	3·37	3·49	3·67	3·73	3·77	3·65	3·13	2·68	2·13	2·04	3·19
a 75	1·79	1·62	1·78	2·13	2·69	3·11	3·25	3·28	3·08	2·58	2·30	2·64	2·52
a 76	2·58	3·14	3·81	4·28	4·69	4·79	4·69	4·43	4·20	3·66	3·61	3·39	3·94
a 77	2·97	2·81	2·60	2·98	3·32	3·39	3·64	3·54	3·40	2·99	2·78	2·98	3·12
a 78	3·04	3·18	3·33	3·70	4·03	4·02	4·03	3·85	3·66	3·30	2·97	3·17	3·52
a 79	2·73	2·59	2·64	2·95	3·19	3·27	3·31	3·13	2·74	2·50	1·90	2·28	2·77
a1880	2·76	2·80	2·96	3·07	3·43	3·53	3·63	3·43	3·14	2·69	2·48	2·26	3·02
a 81	1·83	1·94	2·28	2·93	3·42	3·65	3·61	3·33	2·92	2·86	2·55	2·88	2·85
a 82	3·33	3·33	3·80	3·97	4·26	4·40	4·34	4·24	3·91	3·45	3·00	2·61	3·72
a 83	2·50	2·71	2·92	2·99	3·54	4·23	4·44	4·42	4·05	3·72	3·21	3·36	3·51
a 84	3·01	3·27	3·48	3·98	4·34	4·41	4·20	4·08	3·59	3·25	2·64	2·69	3·58
a 85	2·49	2·28	2·16	2·93	3·75	4·25	4·22	4·27	4·06	3·95	3·70	3·77	3·49
a 86	3·77	3·04	2·87	3·70	4·09	4·18	4·17	4·01	3·70	3·46	3·04	3·07	3·59
a 87	2·83	3·26	4·06	4·06	4·33	4·34	4·12	3·84	3·55	2·95	2·55	2·69	3·55
a 88	2·49	2·22	2·34	2·92	3·26	3·38	3·54	3·48	2·98	2·60	2·53	2·53	2·86
a 89	2·53	2·37	2·23	2·53	2·80	3·22	3·43	3·16	2·71	2·28	1·88	2·26	2·62
a1890	2·60	2·89	3·03	3·47	3·90	4·26	3·89	3·47	3·24	3·04	2·88	2·77	3·29
a 91	2·53	2·51	2·99	2·81	2·72	2·85	2·76	2·53	2·29	1·90	1·33	1·52	2·40
a 92	1·53	1·32	1·38	1·89	2·78	3·53	3·66	3·35	2·97	2·40	1·94	1·79	2·38
a 93	1·39	1·47	1·71	2·39	3·32	3·50	3·23	2·93	2·49	2·13	1·60	1·80	2·33
a 94	2·06	1·94	1·99	2·34	2·82	3·02	3·01	2·68	2·45	2·12	1·75	1·80	2·33
a 95	1·45	1·22	1·25	1·45	1·76	1·84	1·74	1·70	1·54	1·05	0·82	1·10	1·41
a 96	1·18	1·10	1·07	1·47	1·94	2·20	2·09	2·34	1·96	1·71	1·21	1·36	1·64
a 97	1·31	1·51	1·90	2·40	2·82	2·91	2·91	2·79	2·45	1·95	1·69	1·78	2·20
a 98	1·81	2·01	2·29	2·82	3·06	3·08	2·87	2·71	2·27	2·06	1·81	1·76	2·38
99	a 1·89	a 1·68	a 2·07	a 2·32	a 2·72	a 2·83	b 2·76	b 2·59	b 2·14	b 1·98	b 1·85	b 1·40	2·19
b1900	1·60	1·80	2·19	2·44	2·63	2·73	2·56	2·56	2·20	2·03	1·55	1·60	2·16
b 01	1·63	1·19	1·12	1·39	1·56	2·03	2·20	2·14	2·03	1·59	1·19	1·62	1·64
b 02	1·20	0·86	1·13	1·63	2·09	2·33	2·99	3·00	2·64	2·50	2·20	1·98	2·05
b 03	1·81	1·81	2·44	3·20	3·34	3·22	3·18	2·99	2·82	2·39	1·84	1·67	2·56
b 04	1·56	1·61	2·20	3·28	3·60	3·74	3·68	3·38	3·08	2·73	2·24	2·05	2·76
b 05	1·73	1·45	1·55	2·03	2·76	3·22	3·30	3·18	2·90	2·45	2·02	2·05	2·39
b 06	2·10	2·14	2·00	2·43	2·68	2·92	3·02	2·97	2·70	2·38	2·32	2·48	2·51
07	b 2·91	b 2·66	b 2·47	b 2·94	b 3·17	b 3·63	a 3·59	a 3·35	a 3·03	a 2·94	a 2·53	a 2·41	2·97
Mean	572·32	572·25	572·46	572·91	573·33	573·52	573·50	573·36	573·04	572·70	572·33	572·37	572·84

Authority, U. S. Lake Survey, except for supplied values.

a.—Supplied by applying to the Cleveland, O. readings, the mean monthly fall between Cleveland and Amherstburg, as deduced from observations taken during the period from July, 1899, to December, 1904, inclusive.

b.—Self-registering gauge.

NOTE.—Elevations depend on Gauge B. M., 579·337 ft., U. S. Lake Survey, 1903 Levels.

TABLE 10.

WATER LEVELS OF LAKE ERIE.

Monthly mean elevations of water surface of Lake Erie, at Cleveland, O., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1860	573·26	572·90	573·30	574·00	574·21	574·18	573·92	573·76	573·42	573·12	573·03	572·87	573·50
61	2·61	2·33	2·77	3·81	4·24	4·31	4·06	4·10	3·92	3·69	3·67	3·44	3·58
62	3·43	3·14	3·28	4·18	4·42	4·42	4·39	4·01	3·70	3·32	2·98	3·01	3·69
63	3·46	3·75	3·69	3·81	3·99	3·85	3·73	3·65	3·26	2·82	2·41	2·38	3·40
64	2·09	2·24	2·45	2·95	3·65	3·60	3·34	3·07	2·85	2·54	2·37	2·44	2·80
65	2·01	1·43	1·75	2·47	3·05	3·03	2·99	2·91	2·87	2·57	2·19	2·05	2·44
66	1·78	1·62	2·01	2·59	2·81	3·07	3·18	2·93	2·87	2·86	2·62	2·63	2·58
67	2·34	2·02	2·42	2·74	3·26	3·57	3·38	3·07	2·68	2·34	1·84	1·62	2·61
68	1·42	1·04	1·63	2·46	2·91	3·30	3·27	2·75	2·48	2·03	1·87	1·66	2·24
69	1·65	1·58	2·06	2·36	2·91	3·30	3·58	3·48	3·21	2·76	2·30	2·65	2·65
1870	2·89	3·12	2·89	3·54	3·75	3·72	3·76	3·71	3·46	3·08	2·78	2·66	3·28
71	2·45	2·12	2·57	3·05	3·32	3·35	3·33	3·12	2·95	2·28	2·10	1·66	2·69
72	1·58	1·34	1·25	1·45	1·89	2·26	2·25	2·22	1·99	1·82	1·49	1·26	1·73
73	1·16	1·17	1·24	2·52	3·19	3·27	3·25	3·19	2·79	2·49	2·29	2·66	2·44
74	3·05	3·10	3·13	3·30	3·39	3·46	3·49	3·33	2·87	2·43	2·01	1·80	2·95
75	1·57	1·40	1·54	1·94	2·41	2·84	2·97	2·96	2·82	2·33	2·18	2·40	2·28
76	2·36	2·92	3·57	4·09	4·41	4·52	4·41	4·11	3·94	3·41	3·49	3·15	3·70
77	2·75	2·59	2·36	2·79	3·04	3·12	3·36	3·22	3·14	2·74	2·66	2·71	2·88
78	2·82	2·96	3·09	3·51	3·75	3·75	3·75	3·53	3·40	3·05	2·85	2·93	3·28
79	2·51	2·37	2·40	2·76	2·91	3·00	3·03	2·81	2·48	2·25	1·78	2·04	2·53
1880	2·54	2·58	2·72	2·88	3·15	3·26	3·35	3·11	2·88	2·44	2·36	2·02	2·77
81	1·61	1·72	2·04	2·74	3·14	3·38	3·33	3·01	2·66	2·61	2·43	2·64	2·61
82	3·11	3·11	3·56	3·78	3·98	4·13	4·06	3·92	3·65	3·20	2·88	2·37	3·48
83	2·28	2·49	2·68	2·80	3·26	3·96	4·16	4·10	3·79	3·47	3·09	3·12	3·27
84	2·79	3·05	3·24	3·79	4·06	4·14	3·92	3·76	3·33	3·00	2·52	2·45	3·34
85	2·27	2·06	1·92	2·74	3·47	3·98	3·94	3·95	3·80	3·70	3·58	3·53	3·24
86	3·55	2·82	2·63	3·51	3·81	3·91	3·89	3·69	3·44	3·21	2·92	2·83	3·35
87	2·61	3·04	3·82	3·87	4·05	4·07	3·84	3·52	3·29	2·70	2·43	2·45	3·31
88	2·27	2·00	2·10	2·73	2·98	3·11	3·26	3·16	2·72	2·35	2·41	2·29	2·62
89	2·31	2·15	1·99	2·34	2·52	2·95	3·15	2·84	2·45	2·03	1·76	2·02	2·38
1890	2·38	2·67	2·79	3·28	3·62	3·99	3·61	3·15	2·98	2·79	2·76	2·53	3·05
91	2·31	2·29	2·75	2·62	2·44	2·58	2·48	2·21	2·03	1·65	1·21	1·28	2·15
92	1·31	1·10	1·14	1·70	2·50	3·26	3·38	3·03	2·71	2·15	1·82	1·55	2·14
93	1·17	1·25	1·47	2·20	3·04	3·23	2·95	2·61	2·23	1·88	1·48	1·56	2·09
94	1·84	1·72	1·75	2·15	2·54	2·75	2·73	2·36	2·19	1·87	1·63	1·56	2·09
95	1·23	1·00	1·01	1·26	1·48	1·57	1·46	1·38	1·28	0·80	0·70	0·86	1·17
96	0·96	0·88	0·83	1·28	1·66	1·93	1·81	2·02	1·70	1·46	1·09	1·12	1·40
97	1·09	1·29	1·66	2·21	2·54	2·64	2·63	2·47	2·19	1·70	1·57	1·54	1·96
98	1·59	1·79	2·05	2·63	2·78	2·81	2·59	2·39	2·01	1·81	1·69	1·52	2·14
99	1·67	1·46	1·83	2·13	2·44	2·56	2·28	2·09	1·85	1·61	1·62	1·34	1·91
1900	1·36	1·57	1·92	2·23	2·39	2·47	2·34	2·31	1·99	1·75	1·49	1·45	1·94
01	1·35	1·00	0·88	1·29	1·31	1·72	1·91	1·78	1·71	1·33	1·16	1·19	1·39
02	1·08	0·63	0·94	1·49	1·86	2·12	2·74	2·72	2·38	2·29	2·02	1·82	1·84
03	1·72	1·70	2·28	3·05	3·09	3·05	2·98	2·76	2·59	2·25	1·77	1·31	2·38
04	1·19	1·28	1·86	2·91	3·17	3·32	3·41	3·10	2·84	2·49	2·12	1·77	2·46
05	1·52	1·31	1·18	1·83	2·46	2·98	3·06	2·87	2·63	2·31	1·93	1·92	2·17
06	1·94	1·93	1·71	2·13	2·40	2·60	2·64	2·63	2·35	2·21	2·18	2·42	2·26
07	2·76	2·46	2·24	2·71	2·85	3·27	3·31	3·03	2·77	2·69	2·41	2·26	2·73
Mean	572·10	572·03	572·22	572·70	573·05	573·24	573·22	573·04	572·78	572·45	572·21	572·14	572·60

Authority, U.S. Lake Survey.

From January, 1860, to December, 1903, inclusive, data from U. S. Lake Survey Report for 1904, page 4097.

Readings from 1904 to 1907, inclusive, from U. S. Lake Survey Annual Reports.

NOTE.—Elevations depend on B. M. "I" 581·41 ft., U. S. Lake Survey, 1903 Levels.

TABLE 11.

WATER LEVELS OF LAKE ERIE.

Monthly mean elevations of water surface of Lake Erie, at Buffalo Breakwater Light-house, in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
a1860	573·51	572·93	573·28	573·91	574·11	574·15	573·96	573·72	573·44	573·20	573·22	573·25	573·56
a 61	2·86	2·36	2·75	3·72	4·14	4·28	4·10	4·06	3·94	3·77	3·86	3·82	3·64
a 62	3·68	3·17	3·26	4·09	4·32	4·39	4·43	3·97	3·72	3·40	3·17	3·39	3·75
a 63	3·71	3·78	3·67	3·72	3·89	3·82	3·77	3·61	3·28	2·90	2·60	2·76	3·46
a 64	2·34	2·27	2·43	2·84	3·55	3·57	3·38	3·03	2·87	2·62	2·56	2·82	2·86
a 65	2·26	1·46	1·73	2·38	2·95	3·00	3·03	2·87	2·89	2·65	2·38	2·43	2·50
a 66	2·03	1·65	1·99	2·50	2·71	3·04	3·22	2·89	2·89	2·94	2·81	3·01	2·64
a 67	2·59	2·05	2·40	2·65	3·16	3·54	3·42	3·03	2·70	2·42	2·03	2·00	2·67
a 68	1·67	1·07	1·61	2·37	2·81	3·27	3·31	2·71	2·50	2·11	2·06	2·04	2·29
a 69	1·90	1·61	2·04	2·27	2·81	3·27	3·62	3·44	3·23	2·84	2·49	3·03	2·71
a1870	3·14	3·15	2·87	3·45	3·65	3·69	3·80	3·67	3·48	3·16	2·97	3·04	3·34
a 71	2·70	2·15	2·55	2·96	3·22	3·32	3·37	3·08	2·97	2·36	2·29	2·04	2·75
a 72	1·83	1·37	1·23	1·36	1·79	2·23	2·29	2·18	2·01	1·90	1·68	1·64	1·79
a 73	1·41	1·20	1·22	2·43	3·09	3·24	3·29	3·15	2·81	2·57	2·48	3·04	2·49
a 74	3·30	3·13	3·11	3·21	3·29	3·43	3·53	3·29	2·89	2·51	2·20	2·18	3·01
a 75	1·82	1·43	1·52	1·85	2·31	2·81	3·01	2·92	2·84	2·41	2·37	2·78	2·34
a 76	2·61	2·95	3·55	4·00	4·31	4·49	4·45	4·07	3·96	3·49	3·68	3·53	3·76
a 77	3·00	2·62	2·34	2·70	2·94	3·09	3·40	3·18	3·16	2·82	2·85	3·12	2·94
a 78	3·07	2·99	3·07	3·42	3·65	3·72	3·79	3·49	3·42	3·13	3·04	3·31	3·34
a 79	2·76	2·40	2·38	2·67	2·81	2·97	3·07	2·77	2·50	2·33	1·97	2·42	2·59
a1880	2·79	2·61	2·70	2·79	3·05	3·23	3·39	3·07	2·90	2·52	2·55	2·40	2·83
a 81	1·86	1·75	2·02	2·65	3·04	3·35	3·37	2·97	2·68	2·69	2·62	3·02	2·67
a 82	3·36	3·14	3·54	3·69	3·88	4·10	4·10	3·88	3·67	3·28	3·07	2·75	3·54
a 83	2·53	2·52	2·66	2·71	3·16	3·93	4·20	4·06	3·81	3·55	3·28	3·50	3·33
a 84	3·04	3·08	3·22	3·70	3·96	4·11	3·96	3·72	3·35	3·08	2·71	2·83	3·40
a 85	2·52	2·09	1·90	2·65	3·37	3·95	3·98	3·91	3·82	3·78	3·77	3·91	3·30
a 86	3·80	2·85	2·61	3·42	3·71	3·88	3·93	3·65	3·46	3·29	3·11	3·21	3·41
87	a 2·86	a 3·07	3·75	3·71	3·93	4·07	3·91	3·51	3·20	3·26	2·71	2·89	3·41
b 88	2·57	1·96	2·03	2·69	2·84	3·01	3·23	3·12	2·78	2·59	2·44	2·47	2·67
b 89	2·56	2·34	1·95	2·33	2·49	2·96	3·00	2·91	2·53	2·03	2·03	2·34	2·46
b1890	2·93	2·74	2·98	3·23	3·59	3·92	3·64	3·17	2·82	2·81	3·00	2·74	3·13
b 91	2·48	2·36	2·50	2·62	2·40	2·38	2·56	2·27	2·10	1·73	1·67	1·70	2·23
b 92	1·61	0·92	1·12	1·96	2·40	3·21	3·42	3·05	2·78	2·45	2·07	2·04	2·25
b 93	1·27	1·22	1·53	2·19	2·91	3·26	3·13	2·54	2·29	2·19	2·17	2·13	2·24
b 94	2·13	1·75	1·86	2·05	2·55	2·94	2·81	2·34	2·17	2·17	1·99	1·82	2·22
b 95	1·69	1·00	0·92	1·13	1·48	1·58	1·56	1·42	1·44	1·20	0·71	0·97	1·26
b 96	1·12	1·05	0·69	1·22	1·67	1·68	1·86	2·09	1·67	1·41	1·44	1·23	1·43
b 97	1·59	1·15	1·66	2·18	2·60	2·59	2·57	2·45	2·09	1·65	1·69	1·81	2·00
b 98	1·68	1·57	1·95	2·55	2·68	2·72	2·50	2·46	2·08	1·91	2·01	2·07	2·18
99	2·05	1·59	c 1·85	c 2·04	c 2·32	c 2·51	c 2·45	c 2·09	c 1·90	c 1·48	c 1·55	c 1·96	1·98
c1900	1·67	1·61	1·82	2·16	2·33	2·41	2·43	2·31	2·07	1·68	1·84	1·77	2·01
c 01	a 1·60	a 1·03	0·82	1·05	1·17	1·69	1·88	1·70	1·75	1·53	1·39	1·37	1·42
c 02	1·41	0·79	0·95	1·50	1·74	2·05	2·73	2·64	2·30	2·39	2·14	a 2·20	1·90
c 03	1·99	1·70	2·13	2·83	2·85	2·95	2·99	2·64	2·55	2·36	2·01	2·02	2·42
c 04	1·06	1·30	1·86	2·89	3·23	3·49	3·41	3·12	2·84	2·61	2·31	2·13	2·52
c 05	1·74	1·23	1·32	1·79	2·38	2·97	3·28	3·06	2·86	2·65	2·29	2·45	2·34
c 06	2·33	1·88	1·66	2·06	2·27	2·49	2·56	2·51	2·27	2·25	2·32	2·45	2·25
c 07	2·96	2·47	2·22	2·62	2·84	3·18	3·33	3·02	2·80	2·79	2·71	2·63	2·80
Mean	572·36	572·05	572·19	572·64	572·97	573·21	573·26	573·02	572·80	572·56	572·42	572·52	572·67

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied by applying to the Cleveland, O. readings, the mean monthly rise or fall between Cleveland, O. and Buffalo, N. Y., from June, 1899, to December, 1906, inclusive.

b.—Derived from U. S. Lake Survey tables by subtracting 0·1 foot from records there given.

c.—Self-registering gauge.

NOTE.—Elevations depend on B. M. "Light-house," 590·101 ft., U. S. Lake Survey, 1903 Levels.

TABLE 12.

WATER LEVELS OF LAKE ONTARIO.

Monthly mean elevations of water surface of Lake Ontario, at Charlotte, N.Y., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1860	246·58	246·41	246·52	246·54	246·78	246·97	247·09	247·08	246·67	246·41	246·49	246·50	246·67
61	6·28	6·29	6·73	7·27	8·04	8·28	8·29	8·00	7·54	7·69	7·60	7·40	7·45
62	7·04	6·78	6·89	7·75	8·58	8·43	8·32	7·99	7·46	6·96	6·59	6·45	7·44
63	6·52	6·71	6·88	7·47	7·97	7·97	7·73	7·42	6·87	6·44	6·25	6·26	7·04
64	6·10	6·08	6·15	6·69	7·74	8·07	7·67	7·29	6·76	6·47	6·56	6·78	6·86
65	6·51	6·17	6·58	7·21	7·47	7·44	7·24	6·75	6·39	6·04	5·72	5·64	6·60
66	5·45	5·22	5·53	5·88	6·34	7·08	6·85	6·63	6·49	6·37	6·39	6·85	6·26
67	6·79	6·77	6·90	7·31	8·10	8·40	8·08	8·09	7·89	7·35	5·56	5·34	7·21
68	5·16	4·80	5·16	5·82	6·35	6·70	6·57	6·36	6·13	5·43	5·54	5·52	5·79
69	5·38	5·51	5·70	6·44	7·03	7·20	7·47	7·42	7·27	6·97	6·56	6·71	6·64
1870	7·24	7·39	7·32	8·35	9·03	8·81	8·54	8·09	7·49	7·14	6·72	6·52	7·72
71	6·30	6·08	6·37	7·03	7·32	7·25	7·08	6·64	6·30	5·73	5·35	4·78	6·35
72	4·63	4·43	4·30	4·72	4·96	5·28	5·34	5·19	4·94	4·84	4·73	4·54	4·82
73	4·47	4·38	4·55	6·23	6·91	6·96	6·90	6·66	6·22	5·86	5·70	5·83	5·89
74	6·30	6 64	7·08	7·19	7·32	7·28	7·39	7·14	6·64	6·03	5·50	5·20	6·64
75	4·85	4·52	4·68	5·46	5·81	5·86	6·01	5·83	5·60	5·35	5·17	5·07	5·35
76	5·48	6·11	6·70	7·62	8·30	8·42	8·44	8·02	7·35	7·00	6·66	6·39	7·21
77	5·98	5·74	5·85	6·46	6·60	6·41	6·54	6·27	5·86	5·46	5·32	5·46	6·00
78	5·60	5·83	6·34	6·74	7·06	7·05	7·08	6·97	6·82	6·38	6·35	7·03	6·60
79	6·80	6·45	6·47	6·73	6·88	6·91	6·72	6·34	5·94	5·50	5·10	5·12	6·25
1880	5·34	5·63	5·95	6·18	6·38	6·52	6·53	6·16	5·85	5·37	5·27	5·07	5·85
81	4·76	4·85	5·42	5·79	6·09	6·29	6·33	6·00	5·56	5·24	5·24	5·22	5·57
82	5·74	5·94	6·51	6·82	7·09	7·59	7·59	7·22	6·83	6·35	5·86	5·56	6·59
83	5·32	5·39	5·60	6·16	6·76	7·39	7·85	7·70	7·26	6·84	6·59	6·49	6·61
84	6·44	6·85	7·35	8·03	8·16	8·05	7·91	7·65	7·15	6·75	6·22	6·09	7·22
85	6·06	5·78	5·54	6·28	7·07	7·40	7·55	7·36	7·17	6·97	7·00	7·18	6·78
86	7·55	7·56	7·58	8·36	8·59	8·34	7·95	7·50	7·09	6·72	6·43	6·36	7·50
87	6·15	6·84	7·27	7·56	8·08	8·07	7·78	7·29	6·69	6·21	5·72	5·57	6·94
88	5·45	5·26	5·48	5·98	6·19	6·24	6·18	6·01	5·78	5·43	5·31	5·28	5·72
89	5·39	5·69	5·76	5·93	6·18	6·62	6·76	6·52	5·97	5·66	5·33	5·55	5·94
1890	6·16	6·47	6·78	6·99	7·38	7·96	7·89	7·32	6·85	6·62	6·57	6·34	6·94
91	6·02	6·10	6·65	7·27	7·19	6·78	6·47	6·10	5·68	5·04	4·34	4·36	6·00
92	4·57	4·51	4·50	4·90	5·15	5·73	6·25	6·17	5·90	5·48	5·16	5·07	5·28
93	5·06	4·73	5·11	5·81	7·04	7·31	7·09	6·49	6·21	5·77	5·27	5·09	5·92
94	5·43	5·65	6·02	6·09	6·26	6·73	6·52	5·95	5·44	5·15	4·87	4·54	5·72
95	4·55	4·39	4·40	4·74	4·96	4·79	4·53	4·26	4·04	3·64	3·41	3·51	4·27
96	3·77	4·06	4·28	5·15	5·44	5·35	5·13	4·89	4·51	4·29	4·03	3·98	4·57
97	3·84	3·85	4·30	4·96	5·52	5·69	5·63	5·63	4·57	4·58	4·38	4·47	4·84
98	4·70	5·09	5·48	5·90	5·12	6·16	5·87	5·47	5·11	4·83	4·78	4·74	5·36
99	4·88	4·78	5·07	5·61	6·01	6·15	5·95	5·56	5·04	4·71	4·59	4·39	5·23
1900	4·53	4·64	5·08	5·67	6·02	6·00	5·86	5·61	5·17	4·85	4·63	4·87	5·24
01	4·82	4·75	4·50	5·51	5·95	6·07	5·89	5·53	5·21	4·76	4·35	4·35	5·14
02	4·53	4·47	5·03	5·56	5·65	5·67	6·09	6·22	5·81	5·54	5·18	4·96	5·39
03	4·98	5·09	5·68	6·65	6·69	6·60	6·69	6·48	6·20	5·80	5·44	a 5·09	5·95
a 04	4·87	5·05	5·65	6·95	7·63	7·98	8·05	7·79	7·37	6·95	6·32	5·95	6·71
a 05	5·93	5·59	5·55	6·10	6·33	6·74	7·10	7·08	6·91	6·57	6·22	6·09	6·35
06	a 6·36	a 6·36	a 6·14	a 6·35	a 6·51	a 6·60	a 6·75	a 6·45	a 6·03	5·84	5·79	5·91	6·26
07	6·43	6·66	6·62	6·96	7·21	7·27	7·30	7·02	6·68	6·54			
Mean	245·61	245·63	245·88	246·44	246·84	246·98	246·93	246·66	246·28	245·92	245·62	245·56	

Authority, U.S. Lake Survey.
a.—From self-registering gauge.
NOTE.—Elevations depend on B.M. "1",283.168 ft., U.S. Lake Survey, 1903 Levels.

TABLE 13.

WATER LEVELS OF LAKE ONTARIO.

Monthly mean elevations of water surface of Lake Ontario, at Oswego, N.Y., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1860	246·58	246·72	246·77	246·80	247·03	247·57	247·82	247·26	246·86	246·67	246·75	246·73	246·96
61	6·44	6·56	7·01	7·23	8·18	8·54	8·32	8·07	7·60	7·81	7·82	7·61	7·60
62	7·11	6·69	7·18	8·08	8·88	8·62	8·72	8·26	7·61	7·08	6·73	6·62	7·63
63	6·77	6·83	6·91	7·63	8·03	8·18	7·77	7·31	6·93	6·74	6·56	6·57	7·19
64	6·33	6·17	6·26	6·83	7·82	8·12	7·80	7·34	6·81	6·58	6·55	6·65	6·94
65	7·08	7·23	7·38	7·46	7·62	7·66	7·51	6·90	6·29	6·07	5·82	5·66	6·89
66	5·46	5·47	5·48	5·96	6·02	5·92	6·84	6·74	6·65	6·52	6·28	6·20	6·13
67	5·95	5·92	6·62	7·52	8·21	8·48	8·11	7·48	6·98	6·33	5·59	4·83	6·84
68	4·51	4·61	4·88	5·52	6·12	6·54	6·42	6·13	5·94	5·35	5·20	5·37	5·55
69	5·22	5·34	5·56	6·09	6·75	6·97	7·29	7·35	7·17	7·08	6·68	6·85	6·53
1870	7·26	7·41	7·41	8·35	8·95	8·63	8·31	7·97	7·28	6·95	6·38	6·13	7·59
71	6·06	5·89	6·10	6·70	7·12	7·06	6·90	6·46	6·12	5·62	5·21	4·90	6·18
72	4·73	4·51	4·35	4·84	4·96	5·29	5·35	5·19	4·90	4·74	4·69	4·35	4·82
73	4·31	4·38	4·50	6·46	7·00	6·92	6·88	6·60	6·18	5·73	5·60	5·79	5·86
74	6·35	6·75	7·30	7·19	7·17	7·26	7·21	6·98	6·34	5·94	5·37	5·03	6·57
75	4·73	4·38	4·64	5·44	5·71	5·87	5·90	5·76	5·55	5·27	5·08	4·90	5·27
76	5·31	5·97	6·52	7·50	8·08	8·30	8·37	7·91	7·30	6·96	6·60	6·42	7·10
77	5·89	5·62	5·77	6·46	6·53	6·43	6·47	6·20	5·77	5·34	5·25	5·38	5·93
78	5·48	5·69	6·39	6·64	6·98	6·97	6·93	6·85	6·59	6·33	6·21	7·02	6·51
79	6·81	6·45	6·30	6·71	6·80	6·83	6·67	6·32	5·90	5·46	5·07	5·10	6·20
1880	5·32	5·60	5·94	6·12	6·27	6·51	6·52	6·09	5·72	5·31	5·27	5·10	5·81
81	4·74	4·73	5·39	5·81	5·99	6·21	6·28	5·96	5·40	5·18	5·18	5·18	5·50
82	5·73	5·90	6·50	6·83	7·02	7·53	7·52	7·19	6·81	6·30	5·88	5·59	6·57
83	5·32	5·38	5·62	6·14	6·79	7·49	8·02	7·84	7·36	6·92	6·69	6·55	6·68
84	6·51	6·88	7·56	8·17	8·19	8·09	7·88	7·65	7·22	6·80	6·30	6·15	7·28
85	6·14	5·87	5·59	6·27	7·07	7·44	7·58	7·43	7·21	7·02	7·07	7·24	6·83
86	7·60	7·67	7·81	8·43	8·64	8·44	8·04	7·60	7·24	6·95	6·51	6·42	7·61
87	6·17	6·92	07·43	7·64	8·20	8·16	7·88	7·37	6·76	6·37	6·02	5·75	7·06
88	5·44	5·30	5·54	6·17	6·24	6·28	6·34	6·24	5·85	5·49	5·42	5·41	5·81
89	5·62	5·76	5·93	6·17	6·32	6·63	6·82	6·57	6·01	5·57	5·17	5·74	6·03
1890	6·25	6·60	6·93	7·17	7·53	8·16	7·99	7·32	6·97	6·64	6·72	6·51	7·07
91	6·19	6·45	6·99	7·47	7·25	6·83	6·55	6·11	5·68	5·01	4·44	4·41	6·12
92	4·51	4·48	4·61	5·19	5·25	5·81	6·32	6·24	6·04	5·60	5·33	5·20	5·38
93	4·87	4·76	5·24	5·99	7·15	7·37	7·11	6·57	6·30	5·78	5·37	5·22	5·98
94	5·56	5·74	6·04	6·09	6·27	6·80	6·60	6·02	5·51	5·26	4·93	4·58	5·78
95	4·49	4·43	4·33	4·88	5·00	4·88	4·59	4·34	4·00	3·66	3·41	3·44	4·29
96	3·80	4·26	4·49	5·41	5·43	5·35	5·08	4·94	4·46	4·23	3·97	3·97	4·62
97	3·88	3·82	4·32	4·96	5·40	5·61	5·61	5·60	5·10	4·47	4·41	4·47	4·80
98	4·64	5·08	5·48	5·92	6·08	6·13	5·85	5·50	5·09	4·84	4·89	4·90	5·37
99	4·98	4·88	5·13	5·69	5·94	6·07	5·92	5·46 *a*	4·95 *a*	4·55 *a*	4·42 *a*	4·36	5·20
*a*1900	4·63	4·88	5·19	5·80	5·99	5·91	5·82	5·54	5·12	4·72	4·55	4·84	5·25
a 01	4·68	4·62	4·39	5·63	5·91	5·99	5·74	5·42	5·10	4·65	4·28	4·36	5·06
a 02	4·42	4·30	4·95	5·40	5·47	5·55	5·97	6·11	5·66	5·42	5·05	4·89	5·27
a 03	4·92	5·16	5·75	6·44	6·56	6·44	6·59	6·35	6·07	5·72	5·36	5·11	5·87
04	4·72	5·00	5·63	7·00	7·61	7·87	7·89	7·64	7·25	6·87	6·36	5·81	6·64
05	5·79	5·49	5·29	6·13	6·25	6·59	6·98	6·90	6·75	6·45	6·07	5·88	6·21
06	6·13	6·09	5·91	6·25	6·38	6·41	6·57	6·26	5·81	5·48	5·58	5·74	6·05
07	6·34	6·46	6·47	6·85	7·08	7·11	7·12	6·90	6·50	6·48	6·33	6·33	6·66
Mean	245·58	245·65	245·91	246·49	246·82	246·95	246·93	246·63	246·22	245·88	245·63	245·57	246·19

Authority, U.S. Lake Survey.
a.—Self-registering gauge
Floods in Oswego River during the spring may cause abormal gauge readings from 0.2 to 0.3 foot above the true mean stage of Lake Ontario.
NOTE.—Elevations depend on zero of gauge, 244·12 ft., and B.M. "A", 251·90 ft., U.S. Lake Survey, 1903 Levels.

TABLE 14.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Ogdensburg, N.Y., in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
a1860	245·65	245·78	245·83	245·86	246·07	246·58	246·82	246·29	245·91	245·73	245·81	245·79	246·01
a 61	5·52	5·63	6·05	6·26	7·16	7·50	7·29	7·05	6·61	6·81	6·82	6·62	6·61
a 62	6·15	5·75	6·21	7·06	7·82	7·57	7·67	7·23	6·62	6·12	5·79	5·69	6·64
a 63	5·83	5·88	5·96	6·64	7·02	7·16	6·77	6·34	5·98	5·80	5·63	5·64	6·22
a 64	5·41	5·26	5·35	5·88	6·82	7·10	6·80	6·37	5·87	5·65	5·62	5·72	5·99
a 65	6·12	6·26	6·40	6·48	6·63	6·67	6·53	5·95	5·38	5·17	4·93	4·78	5·94
a 66	4·59	4·60	4·61	5·06	5·12	5·03	5·89	5·80	5·72	5·59	5·37	5·29	5·22
a 67	·06	5·03	5·69	6·54	7·19	7·44	7·09	6·50	6·03	5·41	4·72	4·00	5·89
a 68	3·70	3·79	4·05	4·65	5·22	5·61	5·50	5·23	5·05	4·49	4·35	4·51	4·68
69 a	4·37 a	4·48 a	4·69 a	5·15 a	5·81	6·18	6·41	6·41	6·16	6·08	5·70	6·04	5·63
1870	6·32	6·36	6·16	7·35	7·87	7·60	7·36	7·03	6·19	5·87	5·64 a	5·23	6·58
71 a	5·16 a	5·00 a	5·20 a	5·76	6·02	6·28	6 01	5·66	5·34	4·99	4·39 a	4·07	5·32
72 a	3·91 a	3·70 a	3·55 a	4·01	·31	4·53	4·77	4·66	4·59	4·09 a	3·87 a	3·55	4·13
73 a	3·51 a	3·58 a	3·69 a	5·54	6·15	6·18	6·20 a	5·67 a	5·27 a	4·85 a	4·73 a	4·90	5·02
74 a	5·43 a	5·81 a	6·33 a	6·22 a	6·21 a	6·29 a	6·24	6·16 a	5·42 a	5·05 a	4·51 a	4·19	5·66
a 75	3·91	3·58	3·82	4·57	4·83	4·98	5·01	4·88	4·68	4·41	4·24	4·07	4·42
a 76	4·45	5·07	5·59	6·52	7·06	7·27	7·34	6·90	6·33	6·01	5·67	5·50	6·14
a 77	5·00	4·74	4·89	5·54	5·60	5·51	5·55	5·29	4·89	4·48	4·40	4·52	5·03
a 78	4·61	4·81	5·47	5·71	6·03	6·02	5·98	5·90	6·65	5·41	5·30	6·06	5·58
a 79	5·87	5·53	5·39	5·77	5·86	5·88	5·73	5·40	5·01	4·59	4·23	4·25	5·29
a1880	4·46	4·73	5·05	5·22	5·36	5·58	5·59	5·19	4·84	4·45	4·41	4·25	4·93
a 81	3·91	3·91	4·53	4·92	5·09	5·30	5·37	5·06	4·54	4·33	4·33	4·33	4·64
a 82	4·85	5·01	5·57	5·88	6·06	6·54	6·54	6·22	5·87	5·39	4·99	4·72	5·64
a 83	4·46	4·52	4·74	5·23	5·85	6·51	7·01	6·84	6·38	5·97	5 75	5·62	5·74
84 a	5·58 a	5·93 a	6·57 a	7·15 a	7·17 a	7·07 a	6·87 a	6,66	6·39	5·97	5·55 a	5·24	6·35
85 a	5·23 a	4·98 a	4·72 a	5·36 a	6·11	6·47 a	6·59 a	6·45 a	6·24	6·05 a	6·11 a	6·27	5·88
a 86	6·61	6·68	6·81	7·39	7·59	7·40	7·03	6·61	6·27	6·00	5·58	5·50	6·62
87 a	5·26	5·97 a	6·45 a	6·65	7·14	7·08	6·90 a	6·39 a	5·82 a	5·45 a	5·12 a	4·87	6·09
a 88	4·57	4·41	4·67	5·26	5·33	5·37	5·42	5·33	4·96	4·62	4·56	4·55	4·92
a 89	4·74	4·88	5·04	5·26	5·40	5·70	5·88	5·64	5·11	4·70	4·32	4·86	5·13
1890 a	5·34 a	5·67 a	5·98 a	6·21	6·59	7·00	6·97	6·12 a	6·02 a	5·71 a	5·78 a	5·58	6·08
91 a	5·28 a	5·53 a	6·04 a	6·49 a	6·28	5·72	5·49	5·07	4·71	4·29	3·99 a	3·60	5·21
92 a	3·70 a	3·67 a	3·79 a	4·34 a	4·40 a	4·92	5·26	5·15	5·21	4·67	4·36 a	4·35	4·48
a 93	4·04	3·93	4·39	5·09	6·19	6·39	6·15	5·64	5·39	4·90	4·51	4·37	5·08
a 94	4·69	4·86	5·14	5·19	5·36	5·86	5·67	5·12	4·64	4·40	4·09	3·76	4·90
a 95	3·68	3·62	3·53	4·05	4·16	4·05	3·77	3·54	3·22	2·90	2·66	2·69	3·49
a 96	3·03	3·46	3·68	4·55	4·57	4·49	4·24	4·10	3·65	3·43	3·19	31·9	3·80
a 97	3·10	3·05	3·52	4·12	4·54	4·73	4·73	4·73	4·25	3·66	3·60	3·66	3·97
a 98	3·82	4·24	4·61	5·03	5 18	5·23	4·96	4·63	4·24	4·01	4·06	4·07	4·51
a 99	4·14	4·05	4·28	4·81	5·05	5·17	5·03	4·59	4·11	3·74	3·61	3·56	4·34
1900 a	3·81 a	4·05 a	4·34 a	4·91 a	5·09 a	5·02 a	4·93 a	4·67 b	4·14 b	3·85 b	3·69 b	3·96	·37
b 01	3·78	3·55	3·38	4·35	4·82	4·99	4·81	4·53	4·25	3·84	3·44	3·74	4·11
02 b	3·57 b	3·57 b	4·14 b	4·67 b	4·62 b	4·71 b	5·06 b	5·12 b	4·80 b	4·51 b	4·21 a	4·06	4·42
b 03	3·97	4·00	4·68	5·48	5·60	5·43	5·57	5·35	5·13	4·70	4·47	4·24	4 88
04 a	3·90 b	4·04 b	4·47 b	5·86 b	6·45 b	6·75 b	6·82 b	6·64 b	6·22 b	5·89 b	5·36 b	4·81	5·60
a 05	4·91	4·53	4·24	5·09	5·28	5·64	5·95	5·85	5·76	5·48	5·24	5·03	5·25
a 06	5·30	5·11	4·95	5·21	5·38	5·42	5·56	5·31	4·92	4·68	4·62	4·64	5·09
a 07	5·20	5·42	5·32	5·74	6 03	6·05	6·12	5·90	5·51	5·42	5·31	5·34	5·61
Mean	244·70	244·75	244·99	245·54	245·86	246·00	245·98	245·69	245·32	244·99	244·76	244·69	245·27

Authority, U.S. Lake Survey, except for supplied values.

a.—Supplied from Oswego, N.Y., readings by formula (Ogdensburg—240)=0·9426 (Oswego —240)—0·553.

b.—Self-registering gauge.

NOTE.—Elevations depend on zero of gauge, 244·63 ft. and B. M. "O", 247·126 ft., U.S. Lake Survey, 1903, Levels.

TABLE 15.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Lock No. 27, Galop Canal, head of Galop Rapids, in feet above mean tide at New York.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
a1860	244·08	244·22	244·26	244·29	244·80	245·31	245·55	245·02	244·64	244·46	244·54	244·22	244·62
a 61	3·95	4·07	4·49	4·70	5·89	6·23	6·02	5·79	5·34	5·54	5·55	5·06	5·22
a 62	4·59	4·19	4·65	5·50	6·55	6·31	6·40	5·97	5·35	4·85	4·52	4·12	5·25
a 63	4·26	4·32	4·40	5·08	5·75	5·89	5·50	5·07	4·71	4·53	4·36	4·08	4·83
a 64	3·85	3·70	3·78	4·32	5·55	5·83	5·53	5·10	4·60	4·38	4·35	4·15	4·60
a 65	4·56	4·70	4·84	4·92	5·36	5·40	5·26	4·68	4·10	3·90	3·66	3·21	4·55
a 66	3·03	3·04	3·04	3·50	3·85	3·75	4·62	4·53	4·44	4·32	4·09	3·73	3·83
a 67	3·49	3·46	4·12	4·97	5·92	6·17	5·82	5·23	4·76	4·14	3·44	2·43	4·50
a 68	2·93	2·22	2·17	3·08	3·94	4·34	4·22	3·95	3·77	3·21	3·07	2·94	3·35
a 69	2·80	2·91	3·12	3·62	4·54	4·75	5·05	5·11	4·94	4·85	4·47	4·34	4·21
a1870	4·73	4·87	4·87	5·76	6·62	6·32	6·01	5·69	5·04	4·73	4·19	3·66	5·21
a 71	3·59	3·43	3·63	4·20	4·89	4·83	4·68	4·26	3·94	3·47	3·08	2·50	3·88
a 72	2·34	2·13	1·98	2·44	2·85	3·16	3·21	3·06	2·79	2·64	2·59	1·98	2·60
a 73	1·94	2·00	2·12	3·97	4·77	4·70	4·66	4·40	4·00	3·57	3·45	3·34	3·58
a 74	3·87	4·24	4·77	4·66	4·91	5·02	4·97	4·76	4·15	3·77	3·23	2·62	4·25
75	1·45	0·46	1·77	3·24	3·61	3·80	3·79	3·62	3·53	3·15	2·81	2·77	2·83
76	2·91	3·73	4·02	5·35	5·95	6·23	6·25	5·64	4·99	4·92	4·20	3·67	4·82
77	2·37	3·17	3·57	3·80	4·51	4·38	4·56	4·05	3·51	2·90	3·00	2·99	3·57
78	2·97	3·20	4·01	4·63	5·20 b	4·74	4·63	4·53	4·31	3·99	3·84	4·95	4·25
79	3·39	3·75	3·81	4·36	4·14	4·54	4·50	3·86	3·45	2·86	2·94	2·90	3·73
1880	3·03 b	3·48	3·60	4·04	4·14	4·33	4·33	3·91	3·60	3·27	3·29	2·74	3·65
81	1·02	1·56	2·83	3·53	3·72	3·93	4·04	3·73	3·39	3·02	3·06	3·10	3·08
82	3·20	3·44	4·07	4·84	4·69	5·40	5·34	4·95	4·46	4·10	3·67	3·51	4·31
83	1·87	2·01	2·76	3·78	4·56	5·37	5·77	5·58	5·10	4·66	4·59	4·42	4·21
84	3·29	3·76	4·46	5·71	5·92 b	5·81 b	5·61	5·52	5·15	4·67	4·33	4·13	4·86
85	3·73	2·52	2·73	3·69	4·96	5·35	5·45	5·30	5·11	4·87	4·86	5·07	4·47
86	5·15	5·06	5·02	5·90	6·49	6·28	5·83	5·47	5·16	4·76	4·62	4·31	5·34
87	3·97	4·22	4·69	5·39	5·91	5·95	5·67	5·17	4·72	4·40	3·90	3·64	4·80
88	3·49	2·27	2·27	4·05	4·20	4·23	4·22	4·08	3·91	3·26	3·17	3·30	3·54
89	3·51	2·87	3·43	4·01	4·19	4·51	4·61	4·35	3·83	3·12	3·15	3·46	3·75
1890	4·10	4·13	4·64	4·98	5·26	5·89	5·74 b	5·09 b	4·79	4·38	4·32	3·44	4·73
91	3·41	3·48	4·30	5·13	4·93	4·52	4·38	3·99	3·50	2·83	2·59	2·42	3·79
92	2·33	1·83	1·98	2·97	3·16	3·59	4·21	4·03 b	3·87	3·44	3·09	3·10	3·11
93	2·27	1·71	2·29	3·66	4·80	5·12	4·81	4·27	4·17	3·60	3·20	3·08	3·58
94	3·16	2·44	3·49	3·82	4·04	4·61	4·40	3·81	3·37	3·15	2·95	2·39	3·47
95	2·16	1·32	1·59	2·64	2·97	2·81	2·51	2·36	2·11	1·77	1·56	1·72	2·13
96	1·80	1·93	1·86	3·06	3·46	3·29	3·17	3·02	2·54	2·32	2·22	2·04	2·56
97	1·91	1·75	2·25	3·12	3·34	3·73	3·64	3·63	3·07	2·57	2·30	2·37	2·81
98	2·44	2·52	3·58	3·21	3·54	3·59	3·32	3·24	2·85	2·58	2·56	2·61	3·00
99	2·70	2·24	2·72	3·35	3·66	3·84	3·68	3·27	2·81	2·40	2·28	2·35	2·94
1900	2·30	2·35	2·35	3·38	3·54	3·70	3·64	3·26	3·01	3·62	2·37	2·65	2·93
01	2·48	2·13	1·88	3·02	3·58	3·70	3·50	3·21	2·97	2·46	2·00	2·18	2·76
02 c	1·24 c	1·24 c	2·44 c	3·24 c	3·34 c	3·44 c	3·74 c	3·84 c	3·54 b	3·28 c	3·04 c	2·74	2·89
c 03	2·54	2·54	3·24	4·14	4·34	4·14	4·24	4·04	3·54	3·44	3·14	3·04	3·53
04 c	2·54 c	2·54 c	3·04 c	4·54 b	5·35 c	5·54 c	5·74 c	5·38 c	5·00 b	4·65 c	4·08 c	3·34	4·31
c 05	3·08	2·78	2·44	3·68	4·04	4·28	4·70	4·44	4·44	4·28	3·88	3·58	3·80
c 06	3·98	3·66	3·51	3·86	4·01	4·14	4·24	3·96	3·52	3·42	3·38	3·29	3·75
c 07	3·35	3·47	3·63	4·42	4·73	4·78	4·85	4·63	4·19	4·16	4·06	3·93	4·18
Mean	243·07	242·96	243·35	244·12	244·60	244·75	244·72	244·41	244·04	243·70	243·48	243·28	243·87

Authority, U. S. Lake Survey, except for supplied values.

a.—Supplied from Oswego readings by formula, (Lock 27 − 240) = 0·9457 (Oswego − 240) − 1·845 assuming a mean fall during entire period.

b.—Supplied from Oswego readings by formula, (Lock 27 − 240) = 0·9457 (Oswego − 240) − 1·845.

c.—Deduced from the water records of the St. Lawrence canals furnished the International Waterways Commission.

NOTE.—Elevations depend on zero of gauge, sill of Lock No. 27, 234·144 ft.

TABLE 16.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Lock No. 24, Morrisburg Canal, head of Rapide Plat, in feet above upper sill of old lock.

Year	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1880	8·32		8·79	9·49	9·74	9·95	9·89	9·28	8·84	8·34	8·61	7·85	9·01
81	5·69	6·74	7·94	8·77	9·02	9·36	9·56	9·17	8·53	7·89	8·45	8·55	8·31
82	8·54	8·59	9·55			10·77	10·53	10·22	9·89	9·46	8·62	8·52	9·47
83	7·57	5·90	7·65	9·14	9·93	10·78	11·15	11·05	11·06	10·12	9·83	9·58	9·48
84	7·49	8·15	12·41	10·90	11·78	11·61	11·31	11·15	10·85	9·83	9·20	8·64	10·28
85	7·90	7·18	7·55	8·51	10·21	10·61	10·74	10·58	10·09	10·05	9·94	10·39	9·48
86	10·18	10·09	10·32	11·58	11·84	11·71	11·22	10·62	10·40	10·03	9·86	9·69	10·63
87	8·77	10·40	11·13	11·13	11·44	11·41	11·06	10·46	10·07	9·68	8·99	8·48	10·25
88	7·79	6·55	7·50	9·38	9·87	9·83	9·46	9·39	8·97	8·43	8·41	8·36	8·66
89	8·71	8·16	7·96	9·50	9·48	9·92	10·05	9·79	9·13	8·32	7·95	8·77	8·98
1890	9·34	9·54	10·02	10·46		11·47	11·42	10·51	10·21	9·73	9·70	9·36	10·16
91	8·64	8·74	9·60	9·40	10·64	9·97	9·88	9·26	8·68	7·82	7·36	7·30	8·94
92	7·02	5·83	6·44	7·74	7·98	8·74	9·52	9·30	9·22	8·51	8·13	7·98	8·03
93	5·25	7·50	8·63	8·92	10·36	10·80	10·52	9·65	9·48	8·87	8·33	8·06	8·86
94	7·98	6·61	8·71	9·13	9·35	10·18	9·86	9·01	8·40	8·06	7·77	7·32	8·53
95	6·61	5·45	6·09	9·47	7·82	7·65	7·33	7·10	6·54	6·16	5·69	5·81	6·81
96	5·65	6·35	7·73	7·99	8·32	8·28	7·99	7·73	7·09	6·66	6·65	6·35	7·23
97	6·03	5·42	6·45	7·86	8·42	8·76	8·53	8·58	7·81	7·07	6·76	7·07	7·40
98	7·04	7·61	8·35	8·74	9·04	9·10	8·74	8·38	7·83	7·44	7·40	7·59	8·10
99	7·00	6·65	7·53	8·54	8·86	9·16	8·85	8·15	7·55	7·03	7·04	7·01	7·78
1900	6·91	6·89	7·16	8·50	8·88	8·93	8·84	8·32	7·90	7·40	7·12	7·59	7·87
01	7·29	7·00	7·14	8·14	8·65	9·03	8·73	8·37	8·18	7·65	7·09	7·04	7·86
a 02	7·00	5·80	7·80	8·60	8·70	8·90	9·10	9·40	8·11	8·60	8·30	7·10	8·12
a 03	8·00	7·70	8·90	9·90	9·11	9·80	9·11	9·80	9·10	8·90	8·00	7·70	8·84
a 04	6·90	7·10	7·80	9·80	10·50	10·10	11·00	10·86	10·26	10·00	9·20	8·20	9·31
a 05	7·16	10·40	9·20	9·10	9·10	9·46	9·90	9·90	9·70	9·40	9·00	8·90	9·27
a 06	9·08	8·78	8·57	9·00	9·25	9·41	9·52	9·18	8·65	8·44	8·28	8·22	8·86
a 07	8·08	8·45	9·39	10·30	10·07	10·17	10·24	10·00	10·02	9·90	9·19	9·17	9·58
Mean	7·57	7·54	8·44	9·26	9·55	9·85	9·79	9·47	9·02	8·56	8·25	8·09	8·78

Authority, U. S. Lake Survey, except for supplied values.

a.—Deduced from the water records of the St. Lawrence canals furnished the International Waterways Commission.

TABLE 17.

WATER LEVELS OF ST. LAWRENCE RIVER.

Monthly mean elevations of water surface of St. Lawrence River, at Lock No. 21, Cornwall Canal, head of Long Sault Rapids, in feet above upper sill of old lock.

Year	Jan.	Feb.	Mar.	April.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1870	10·99	10·94	10·70	12·00	12·54	12·43	12·25	1 85	11·20	11·07	10·62	10·36	11·41
71	9·89	9·71	10·32	0·74	11·06	11·08	10·91	10·54	10·24	9·87	9·34	9·03	10·23
72	8·44	7·75	8·02	8·78	9·21	9·53	9·57	9·37	9·11	8·97	9·08	8·67	8·88
73	9·50	8·98	9·20	10·10	10·81	10·97	10·90	10·58	10·34	9·2	9·74	10·02	10·09
74	10·30	10·30	11·06	11·08	1·19	11·30	11·2	10·95	10·41	10·13	9·74	9·33	10·59
75	8·41	7·43	8·53	9·41	9·88	10·05	10·12	9·92	9·65	9·37	9·20	9·11	9·26
76	9·46	9·83	10·16	1 ·43	11·91	12·11	12·15	11·71	11·18	11·02	10·57	10·64	11·01
77	10·04	10·06	10·17	10·41	10·59	10·51	10·56	10·27	9·87	9·43	9·37	9·50	10·06
78	9·44	9·40	10·21	10·62	10·92	10·93	10·85	10·84	10·73	10·41	10·33	11·00	10·47
79	10·44	9·51	9·52	10·60	10·86	10·84	10·68	10·29	9·9	9·58	9·31	9·10	10·06
1880	9·40	9·85	9·83	10·32	10·45	10·61	10·55	10·09	9·82	9·46	9·59	9·34	9·94
81	8·18	7·18	9·02	9·77	10·01	10·25	10·29	9·96	9·59	9·33	9·35	9·30	9·35
82	9·60	9·54	10·40	10·65	10·80	11·38	11·36	11·01		10·21	9·75	9·63	10·39
83	9·11	8·91	9·07	9·99	10·64	11·29	11·67	11·55	11·21	10·02	10·66	10·42	10·43
84	10·59	0·79	10·63	11·73	11·82	11·66	11·60	11·37	10·98	10·51	10·23	9·94	10·99
85	·90	9·93	9·50	9·87	10·82	11·24	11·22	11·03	10·84	10·66	10·76	10·99	10·56
86	10·80	9·57	10·50	11·91	12·17	12·02	11·70	11·32	11·02	10·68	10·52	10·42	11·05
87	11·06	11·79	11·81	11·52	11·80	11·77	11·52	11·05	10·54	10·28	9·73	9·62	11·04
88	9·52	8·81	9·63	10·09	10·18	10·23	10·24	10·20	9·88	9·55	9·48	9·53	9·78
89	9·68	8·94	9·30	10·23	10·24	10·61	10·75	10·48	10·00	9·51	9·31	9·80	9·90
890	10·24	10·23	10·72	11·07	11·42	11·83	11·76	11·21	10·94	10·53	10·62	10·39	10·91
91	10·08	9·80	10·55	11·33	11·15	10·66	10·50	10·15	9·76	9·06	8·75	8·79	10·05
92	8·66	7·67	8·37	9·29	9·30	9·86	10·40	10·18	10·14	9·73	9·46	15·52	9·88
9	14·80	15·20	15·29	16·32	10·90	11·12	10·94	10·39	10·33	9·78	9·51	9·21	11·98
94	9·32	8·18	9·73	9·99	10·15	10·66	10·44	9·94	9·55	9·26	9·04	8·62	9·57
95	8·46	6·93	7·38	8·86	8·97	8·92	8·64	8·62	8·23	7·95	7·64	7·57	8·18
96	8·26	8· 8	8·54	9·28	9·42	9·38	9·19	9·02	8·54	8·19	8·22	7·99	8·73
97	7·85	7·46	8·49	9·07	9·48	9·69	9·59	9·56	9·01	8·45	8·33	8·48	8·79
98	8·48	9·59	9·51	9·66	9·82	9·84	9·64	9·37	9·03	8·65	8·67	8·77	9·25
99	8·70	8·56	9·63	9·48	9·73	9·93	9·72	9·25	8·85	8·45	8·38	8·54	9·10
1 00	8·59	8·59	6·55	9·68	9·87	9·91	9·86	9·56	9·30	8·85	8·71	9·00	9·0[illegible]
01	8·86	9·21	9·03	9·57	9·88	10·02	9·75	9·50	9·27	8·93	8·44	8·61	9·26
a 02	8·80	13·40	9·00	9·40	9·70	9·90	10·10	10·20	9·10	9·60	9·00	9·00	9·77
a 03	8·11	8·80	9·60	10·40	10·60	10·10	10·60	10·50	10·20	9·70	9·10	8·10	9·65
a 04	8·12	10·10	9·20	10·40	9·70	11·20	11·30	11·40	10·90	10·20	9·10	9·10	10·06
a 05	8·10	7·40	7·80	9·80	9·80	10·00	10·22	10·21	10·12	9·88	9·58	9·28	9·35
a 06	9·59	9·58	9·25	9·50	9·59	9·66	9·75	9·52	9·12	8·82	8·86	9·12	9·36
a 07	9·14	8·94	9·22	10·12	10·27	10·30	10·39	10·26	9·87	9·89	9·78	9·83	9·83
Mean	9·44	9·41	9·62	10·38	10·46	10·63	10·60	10·35	9·97	9·65	9·42	9·52	9·95

Authority, U. S. Lake Survey, except for supplied values.

a.—Deduced from the water records of the St. Lawrence canals furnished the International Waterways Commission.

TABLE 19.

DISCHARGE FROM LAKE SUPERIOR.

Monthly mean outflow from Lake Superior, through St. Marys River, in 100 cubic feet per second.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean.
1860	942	880	875	932	1018	1062	1062	1075	1057	1066	1025	932	994
61	875	813	780	870	1048	1087	1133	1126	1192	1098	1018	919	988
62	826	778	785	794	983	986	988	1029	1043	1027	949	875	922
63	820	785	746	750	813	799	840	986	976	937	854	817	844
64	739	686	702	702	771	810	840	845	866	806	760	714	770
65	661	654	624	721	866	965	1048	1068	1057	1009	884	801	863
66	723	670	670	769	859	907	983	1038	962	967	889	903	862
67	829	799	755	801	834	976	1062	1036	1041	1036	935	850	913
68	801	661	744	783	907	891	951	935	951	944	979	868	868
69	806	746	642	771	896	903	997	1105	1287	1168	1087	926	944
1870	856	804	806	824	932	893	946	949	974	937	893	668	874
71	744	707	644	677	808	903	844	926	937	891	840	750	814
72	693	674	619	610	815	854	946	1020	1036	1002	967	863	842
73	771	732	737	741	870	900	1002	1059	1075	1048	997	942	906
74	815	778	753	725	822	921	1006	1020	1016	1045	995	972	906
75	866	808	799	856	928	997	1016	1020	1085	1055	990	861	940
76	854	843	783	792	958	1092	1200	1211	1218	1142	1078	965	1011
77	898	905	877	850	850	900	976	1004	949	958	903	866	911
78	815	755	732	728	792	852	877	868	801	826	808	757	801
79	665	573	518	548	633	665	734	741	723	730	688	596	651
1880	550	543	522	525	695	870	926	898	935	882	889	824	755
81	753	730	734	709	806	859	905	886	930	1036	1013	937	858
82	820	769	741	730	824	845	926	949	935	914	900	838	849
83	739	718	718	734	732	817	859	956	880	845	820	760	798
84	737	693	672	633	718	741	792	801	817	838	861	801	759
85	762	737	704	665	799	877	919	969	914	873	856	787	822
86	707	670	670	665	776	813	852	884	852	859	843	744	778
87	693	661	654	622	704	808	893	866	834	875	822	728	763
88	691	612	624	622	760	956	992	990	972	969	923	778	824
89	722	664	670	668	780	816	870	872	870	840	780	704	771
1890	714	604	602	588	682	798	870	852	830	816	788	728	739
91	590	612	582	618	704	694	716	718	704	716	694	632	665
92	620	548	512	544	646	718	746	748	760	738	682	626	657
93	519	482	484	531	638	738	775	790	766	755	745	644	656
94	602	587	566	638	822	868	894	896	871	879	860	804	774
95	747	721	683	679	755	828	873	875	907	930	832	830	805
96	727	687	649	701	816	893	918	921	897	816	822	810	805
97	767	709	712	737	803	871	912	942	910	871	850	758	820
98	670	627	599	623	678	755	819	841	866	836	804	789	742
99	699	668	648	657	819	902	940	968	1004	942	926	917	841
1900	793	770	723	730	764	777	818	857	948	954	974	900	834
01	818	764	725	745	798	814	888	920	895	798	788	728	807
02	670	625	613	638	667	725	760	762	770	746	757	731	705
03	660	624	610	649	709	774	795	810	813	838	818	750	737
04	666	630	593	649	700	739	760	771	787	813	796	732	720
05	788	712	670	747	801	834	899	923	958	965	923	884	842
06	821	760	720	733	792	843	880	873	873	855	823	779	813
07	718	683	666	712	734	810	849	880	917	919	891	803	798
Mean	745	701	680	703	798	857	908	927	928	913	875	804	820

TABLE 20.

DISCHARGE FROM LAKE MICHIGAN-HURON.

Monthly mean outflow from Lake Michigan-Huron, through Detroit River, in 100 cubic feet per second.

Year	Jan.	Feb.	Mar.	April	May	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1860	2125	1447	1942	2051	2214	2326	2002	1995	1894	2376	1935	2250	2046
61	a2306	1723	2166	2290	2164	2274	2324	2409	2358	2299	2262	2264	2237
62	2053	1521	2024	2446	2358	2393	2370	2428	2411	2398	2362	2212	2248
63	2153	2040	1878	2122	2307	2204	2340	2336	2363	2202	2263	2187	2200
64	a2278	2043	2048	a2201	2309	2453	2376	2341	2310	2121	2162	2133	2231
65	1594	1446	1693	2092	2204	2241	2333	2340	2312	2276	2179	2087	2067
66	a2026	1928	1850	a1964	2098	2183	2268	2256	2243	2228	2295	2272	2134
67	1881	1996	1641	a2118	2299	2427	2381	2420	2337	2231	2154	2093	2165
68	a2042	1733	2179	2095	2209	2266	2211	2180	2146	2064	2016	1998	2095
69	1844	1692	1607	1976	1848	2030	2184	2211	2192	2091	2721	2133	1994
1870	a2021	1757	1853	2154	2212	2354	2456	2431	2373	2258	2248	2210	2193
71	2059	1679	a2257	2370	2429	2463	2466	2415	2319	2186	2174	2334	2263
72	1995	2032	1936	a1996	2100	2217	2059	2132	2126	2146	2024	2005	2064
73	1796	1924	2069	a1991	1997	2133	2195	2201	2202	2141	2134	2067	2071
74	1470	1053	1947	2053	1998	2106	2168	2164	2200	2185	2183	2027	1963
75	2008	2045	2093	2027	2187	2157	2218	2175	2140	2177	2158	1980	2114
76	2060	2160	a2188	2240	1955	2511	2627	2618	2389	2352	2300	a2283	2307
77	a2371	1947	1342	1753	1799	2251	2290	2277	2164	2232	1943	2149	2043
78	2054	1518	1566	2217	2231	2271	2316	2330	2178	2168	2088	1855	2066
79	1771	1482	1849	2062	1950	2078	2104	2052	2058	1961	1978	1956	1942
1880	1931	1709	1903	1974	1983	2176	2095	2216	2153	2089	2058	2054	2028
81	1756	1968	1891	2025	2083	2182	2178	2209	2247	2137	2288	2232	2100
82	2225	2045	2194	2182	2368	2206	2580	2615	2321	2271	2251	a2139	2283
83	a2238	2228	1856	2156	2230	2434	2754	2716	2538	2402	2307	2211	2339
84	1514	1703	2426	2428	2444	2531	2611	2489	2410	2367	2336	2384	2304
85	a2398	2352	a2364	a2287	2386	2445	2376	2432	2396	2217	2276	2204	2344
86	1677	1490	2008	2118	2428	2432	2418	2406	2403	2304	2298	2403	2204
87	2289	2253	1985	2133	2202	2261	2319	2316	2233	2217	2109	2016	2194
88	2090	2086	1922	2104	2036	2120	2208	2177	2186	2131	2079	1992	2094
89	2099	1701	1716	1792	1934	2100	2086	2097	2113	2020	1988	1817	1955
1890	1940	1797	1745	1823	1839	1964	2046	2066	1994	1919	1950	1875	1913
91	1718	1809	1534	1830	1865	1885	1931	1952	1943	1878	1912	1873	1844
92	1683	1425	1508	1767	1787	1864	1908	1926	1981	1905	1843	1753	1779
93	1464	1514	1851	1883	1817	1950	2047	2052	2034	1988	1990	1958	1879
94	1876	1689	1877	1867	1981	2045	2048	2051	2026	1971	1952	1882	1940
95	a1878	a1842	1988	1732	1814	1861	1898	1895	1868	1794	1722	1748	1837
96	1736	1410	1540	1681	1688	1791	1888	1898	1837	1842	1840	1683	1736
97	1925	a1784	1907	1849	1950	1871	1931	1932	1926	1898	1916	1807	1891
98	1756	1482	1888	1848	1818	1893	1986	1931	1964	1896	1969	1996	1869
99	1947	a1856	1366	1655	1872	1935	2022	2031	2015	1923	1883	1822	1856
1900	1736	1778	1874	1780	1796	1868	1932	1957	1978	1953	1974	1911	1878
01	1719	1410	1548	1161	1706	1986	2052	2084	2025	1983	1963	1935	1798
02	1522	1464	1827	1816	1818	1936	2054	2003	1944	1905	1846	1919	1838
03	1988	1851	1837	1879	1803	1911	1958	1978	1997	1999	1910	2138	1937
04	1612	1682	a1825	2035	1902	2031	2083	2103	2079	2035	1992	2019	1950
05	1580	1534	1676	1947	1922	2066	2118	2124	2094	2052	2004	1942	1922
06	1991	1548	1600	1905	1993	2034	2089	2082	2039	2021	1994	1895	1933
07	1779	1711	1749	1931	1962	1990	2075	2028	2047	2017	1961	1952	1934
Mean	1916	1756	1865	1996	2047	2148	2195	2197	2157	2110	2075	2043	2042

a.—St. Clair River discharge used.

TABLE 21.

DISCHARGE FROM LAKE ERIE.

Monthly mean outflow from Lake Erie, through Niagara River, in 100 cubic feet per second.

Year	Jan.	Feb.	Mar.	April.	May	June	July	Aug.	Sepr.	Oct.	Nov.	Dec.	Mean
1860	2321	2178	2265	2423	2475	2486	2436	2375	2304	2244	2248	2256	2334
61	2161	2045	2136	2375	2485	2521	2474	2436	2431	2387	2410	2410	2357
62	2365	2237	2258	2471	2531	2551	2562	2439	2375	2294	2237	2291	2384
63	2372	2390	2361	2375	2418	1400	2387	2346	2264	2172	2101	2137	2311
64	2041	2052	2061	2157	2332	2337	2288	2203	2165	2105	2091	2153	2163
65	2022	1846	1904	2050	2183	2195	2203	2165	2171	2112	2050	2061	2080
66	1971	1887	1962	2077	2125	2206	2248	2169	1269	1281	2150	2197	2112
67	2098	1975	2055	2112	2234	2330	2298	2203	2123	2058	1970	1964	2118
68	1891	1765	1878	2048	2149	2261	2270	2125	2077	1987	1976	1973	2033
69	1941	1878	1973	2025	2149	2261	2348	2304	2251	2157	2075	2203	2130
1870	2229	2231	2164	2306	2356	2368	2395	2361	2314	2234	2188	2206	2279
71	2123	1997	2088	2185	2248	2273	2285	2215	2188	2045	2029	1973	2137
72	1925	1828	1798	1825	1917	2016	2029	2005	1966	1941	1893	1885	1919
73	1835	1792	1796	2061	2217	2255	2267	2231	2150	2094	2072	2206	2081
74	2269	2227	2221	2246	2267	2301	2327	2267	2170	2079	2009	2005	2199
75	1923	1840	1860	1929	2033	2149	2197	2176	2157	2056	2047	2143	2043
76	2102	2183	2332	2446	2528	2578	2567	2465	2435	2317	2365	2327	2387
77	2196	2105	2041	2124	2181	2217	2294	2239	2234	2152	2159	2225	2181
78	2213	2195	2213	2298	2356	2375	2393	2317	2298	2227	2206	2271	2280
79	1237	2055	2051	2118	2149	2187	2213	2140	2077	2038	1956	2059	2098
1880	2146	2103	2124	2145	2207	2251	2291	2213	2172	2081	2088	2055	2156
81	1931	1908	1968	2112	2205	2281	2286	2188	2119	2121	2105	2200	2119
82	2283	2229	2330	2367	2416	2474	2474	2416	2362	2265	2213	2135	2330
83	2084	2081	2115	2126	2234	2427	2500	2462	2397	2332	2265	2320	2279
84	2206	2215	2248	2370	2436	2475	2436	2375	2281	2215	2126	2155	2295
85	2081	1984	1941	2112	2286	2434	2441	2423	2400	2390	2387	4223	2275
86	2395	2159	2103	2298	2372	2416	2428	2357	2307	2267	2222	2246	2298
87	2161	2212	2383	2372	2427	2465	2423	2322	2244	2258	2125	2170	2297
88	2094	1954	1971	2121	2157	2197	2251	2225	2142	2098	2064	2133	2117
89	2091	2041	1952	2038	2075	2186	2196	2174	2084	1970	1970	2041	2068
1890	2178	2133	2191	2251	2342	2426	2354	2237	2152	2150	2196	2133	2229
91	2072	2046	2077	2106	2054	2050	2091	2052	1986	1903	1891	1897	2016
92	1878	1733	1775	1954	2054	2246	2299	2208	2143	2066	1978	1973	2026
93	1806	1976	1861	2006	2174	2258	2224	2086	2028	2006	2001	1993	2020
94	1993	1908	1931	1974	2088	2182	2150	2040	2002	2002	1962	1923	2013
95	1896	1749	1733	1777	1850	1872	1867	1838	1842	1792	1691	1744	1804
96	1775	1760	1687	1796	1891	1893	1932	1983	1891	1836	1842	1797	1840
97	1875	1781	1888	2004	2101	2097	2093	2066	1984	1886	1895	1921	1966
98	1893	1870	1951	2008	2119	2128	2077	2068	1981	1943	1965	1978	2005
99	1974	1875	1929	1973	2036	2079	2066	1983	1041	1850	1866	1954	1961
1900	1891	1878	1923	1999	2038	2056	2061	3024	1978	1893	1927	1912	1966
01	1876	1755	1712	1760	1786	1896	1936	1897	1908	1861	1831	1827	1837
02	1836	1706	1739	1855	1906	1975	2130	2110	2031	2053	1995	2009	1945
03	1961	1897	1992	2154	2159	2184	2194	2110	2088	2045	1966	1968	2060
04	1762	1813	1931	2170	2252	2317	2296	2225	2157	2103	2033	1993	2088
05	1906	1797	1816	1917	2049	2188	2254	2209	2161	2112	2092	2066	2043
06	2038	1936	1889	1977	2025	2075	2091	2078	2025	2020	2036	2066	2021
07	2185	2070	2014	2105	2157	2239	2276	2200	2148	2145	1226	2108	2148
Mean	2050	1981	2012	2116	2192	2251	2263	2203	2152	2095	2063	2085	2122

Discharge values include a flow of 1000 c. f. s. through Erie Canal, and one of 1100 c. f. s. through Welland Canal.

TABLE 22.

DISCHARGE FROM LAKE ONTARIO.

Monthly mean outflow from Lake Ontario, through St. Lawrence River, in 100 cubic feet per second.

Year	Jan.	Feb.	Mar.	April.	May.	June	July	Aug.	Sept.	Oct.	Nov.	Dec.	Mean
1860	2629	2661	2689	2699	2883	3062	3146	2960	2827	2767	2794	2676	2816
61	2587	2615	2754	2826	3267	3390	3313	3215	3072	3141	3147	2949	3023
62	2789	2656	2808	3103	3512	3404	3454	3280	3075	2900	2788	2642	3034
63	2689	2698	2725	2956	3218	3267	3128	2977	2850	2790	2732	2619	2887
64	2544	2496	2532	2698	3146	3246	3140	2989	2814	2740	2730	2652	2811
65	2778	2826	2873	2900	3079	3093	3040	2842	2659	2584	2501	2350	2794
66	2286	2288	2297	2432	2565	2543	2822	2791	2772	2720	2655	2505	2556
67	2438	2428	2642	2929	3278	3370	3243	3030	2866	2659	2445	2111	2787
68	1699	2049	2126	2309	2605	2725	2699	2609	2552	2370	2326	2266	2361
69	2223	2257	2322	2480	2794	3076	3091	3029	2862	2845	2717	2852	2712
1870	2748	[21]2040	[21]2760	3232	3505	3441	3432	3298	2795	2681	2898	2493	2944
71	2471	2419	2483	2658	2722	3131	2921	2857	2749	2722	2361	2132	2636
72	[21]2062	[21]1873	[21]1945	2114	2448	2453	2675	2665	2768	2366	2177	1978	2294
73	1967	1992	2019	2592	3016	3121	3183	2746	2613	2486	2447	2381	2547
74	2551	[21]2632	2849	2812	2933	2960	2945	3039	2662	2551	2377	2168	2707
75	[21]1843	[12]1579	[27]1935	2435	2428	2410	2484	2478	2320	2329	2402	2253	2244
76	2229	[21]2478	[27]2583	2931	3041	3023	3112	3164	3042	2672	2926	2748	2829
77	[27]2100	2337	[1]2452	2706	2546	2560	2424	2594	2580	2586	2433	2245	2464
78	[27]2273	[27]2342	2493	2570	2370	2875	2930	2920	2816	2792	2786	2711	2656
79	[27]2398	[27]2378	[21]2381	2550	2950	2882	2727	2884	2759	2724	2297	2346	2606
1880	2165	2424	2355	2513	2599	2696	2710	2597	2449	2276	2212	2152	2429
81	[27]1726	[21]1723	[21]2230	2598	2641	2710	2699	2605	2278	2343	2313	2281	2346
82	[27]2342	[21]2387	2553	2579	2975	2901	2970	2937	2946	2670	2566	2385	2684
83	[27]1959	[21]1872	[24]2213	2411	2827	2892	3180	3141	3001	2886	2664	2662	2642
84	[24]2184	[24]3224	[27]2724	3029	3248	3224	3153	2944	2963	2876	2657	2454	2815
85	[24]2270	[24]2121	[24]2197	2600	2771	2855	2920	2884	2792	2784	2877	2879	2662
86	[24]2787	[24]2397	[21]2693	3159	3208	3172	3140	2928	2780	2829	2399	2614	2842
87	[21]2460	[27]2650	[27]2796	3075	3212	3074	3128	2942	2624	2458	2519	2449	2782
88	2225	[24]1996	[27]2072	2555	2500	2523	2599	2615	2311	2475	2478	2366	2393
89	2408	[21]2207	[24]2283	2594	2601	2678	2819	2754	2571	2666	2228	2264	2506
1890	[24]2589	2614	[24]2748	2890	3128	3020	3155	2643	2866	2816	2956	2591	2835
91	[27]2404	[27]2425	[24]2649	3122	3033	2693	2530	2374	2382	2440	2299	2023	2531
92	[24]2089	[21]1851	[21]1974	2392	2310	2549	2400	2436	2655	2387	2323	2304	2306
93	[21]1752	[27]1915	[27]2077	2353	3040	2994	2980	2826	2608	2519	2400	2339	2484
94	2297	[21]1990	[27]2428	2673	2687	2793	2746	2600	2410	2319	2136	2206	2440
95	1989	[21]1659	[21]1774	2034	2197	2202	2134	2006	1866	1794	1710	1625	1916
96	[24]1825	1923	[27]1956	2230	2252	2306	2120	2088	1985	1924	1754	1648	2002
97	1890	[24]1873	[21]1976	2022	2321	2198	2280	2290	1221	1972	2108	2120	2098
98	[21]2074	[27]2143	2191	2580	2878	2898	2801	2501	2372	2327	2390	2069	2435
99	2078	[24]2063	2190	2289	2644	2634	2603	2434	2266	2180	2135	2034	2296
1900	2022	[24]2063	[21]1566	2365	2781	2575	2520	2530	2141	2135	2151	2266	2256
01	[27]2131	1989	1893	2364	2442	2538	2496	2414	2305	2238	2152	2133	2250
02	[27]1780	[27]1522	[27]2120	2227	2411	2434	2590	2573	2451	2337	2196	2265	2242
03	[24]1970	2049	2236	2746	2711	2681	2769	2673	2672	2289	2272	2176	2437
04	[24]1973	1969	2048	236	26759	2888	2767	2904	2726	2640	2508	2169	2470
05	[21]1968	[21]1779	[21]1886	2211	2449	2666	2668	2778	2671	2475	2536	2220	2359
06	[21]2403	2244	2191	2518	2589	2527	2606	2551	2464	2283	2249	2339	2414
07	[21]2266	[21]2207	[21]2291	2664	2741	2720	2742	2672	2590	2509	2467	2284	2513
Mean	2236	2193	2333	2606	2795	2835	2836	2750	2621	2526	2450	2341	2544

NOTE.—21, 24, and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24, and 27, respectively.

TABLE 24.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich.						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1860									
Jan.		602·69	602·22			942	0·277		
Feb.	602·565	2·44	1·95	—0·135	— 459	880	0.259	421	0·124
Mar.	2·43	2·42	1.93	+0·125	+ 425	875	0·257	1300	0·382
Apr.	2·555	2·69	2·18	+0·250	+ 850	932	0·274	1782	0·524
May	2·805	2.92	2·55	+0·200	+ 680	1018	0·299	1698	0·499
June	3·005	3·09	2·74	+0·065	+ 221	1062	0·312	1283	0·377
July	3·07	3·05	2·74	+0·005	+ 17	1062	0·312	1079	0·317
Aug.	3·075	3·10	2·80	+0·015	+ 51	1075	0·316	1126	0·331
Sept.	3·09	3·08	2·72	+0·010	+ 34	1057	0·311	1091	0·321
Oct.	3·10	3·12	2·76	−0·065	− 221	1066	0·313	845	0·248
Nov.	3·035	2·95	2·58	−0·260	− 884	1025	0·301	141	0·041
Dec.	2·775	2·60	2·18	−0·275	− 935	932	0·274	− 3	— 0·001
1861									
Jan.	2·50	2·40	1·93	−0·225	− 765	875	0·257	110	0·032
Feb.	2·275	2·15	1·66	−0·195	— 663	813	0·239	150	0·044
Mar.	2·08	2·01	1·52	+0·135	+ 459	780	0·229	1239	0·364
Apr.	2·215	2·42	1·91	+0·520	+1768	870	0·256	2638	0·776
May.	2·735	3·05	2·68	+0·390	+1326	1048	0·308	2374	0·698
June	3·125	3·20	2·85	+0·155	+ 527	1087	0·320	1614	0·475
July	3·28	3·36	3·05	+0·060	+ 204	1133	0·333	1337	0·393
Aug.	3·34	3·32	3·02	−0·065	− 221	1126	0·331	905	0·266
Sept.	3·275	3·23	2·87	−0·030	− 102	1092	0·321	990	0·291
Oct.	3·245	3·26	2·90	−0.155	− 527	1098	0·323	571	—0·168
Nov.	3.09	2.92	2.55	—0.360	—1224	1018	0.277	206	—0.061
Dec.	2·73	2·54	2·12	−0·365	−1241	919	0·270	− 322	—0·095
1862									
Jan.	2·365	2·19	1·72	−0·270	− 918	826	0·243	— 92	—0·027
Feb.	2·095	2·00	1·51	−0·080	— 272	778	0·229	506	0·149
Mar.	2·015	2·03	1·54	+0·045	+ 153	785	0·231	938	0·276
Apr.	2·06	2·09	1·58	+0·370	+1258	794	0·233	2052	0·603
May	2·43	2·77	2·40	+0·335	+1139	983	0·289	2122	0·624
June	2·765	2·76	2·41	−0·020	− 68	986	0·290	918	0·270
July	2·745	2·73	2·42	+0·070	+ 238	988	0·290	1226	0·360
Aug.	2·815	2·90	2·60	+0·145	+ 493	1029	0·303	1522	0·448
Sept.	2·96	3·02	2·66	+0·025	+ 85	1043	0·307	1128	0·332
Oct.	2·985	2·95	2·59	−0·200	− 680	1027	0·302	347	0·102
Nov.	2·785	2·62	2·25	−0·300	—1020	949	0·279	— 71	—0·021
Dec.	2·485	2·35	1·93	—0·230	— 782	875	0.257	93	0·027
1863									
Jan.	2·255	2·16	1·69	—0·160	− 544	820	0·241	276	0·081
Feb.	2·095	2·03	1·54	−0·150	− 510	785	0·231	275	0·081
Mar.	1·945	1·86	1·37	−0·065	− 221	746	0·219	525	0·154
Apr.	1·88	1·90	1·39	+0.085	+ 289	750	0·221	1039	0·306
May	1·965	2·03	1·66	+0·025	+ 85	813	0·239	898	0·264
June	1·99	1·95	1·60	+0·030	+ 102	799	0·235	901	0·265
July	2·02	2·09	1·78	+0·380	+1292	840	0·247	2132	0·627
Aug.	2·40	2·71	2·41	+0·320	+1088	986	0·290	2074	0·610
Sept.	2·72	2·73	2·37	−0·075	− 255	976	0·287	721	0·212
Oct.	2·645	2·56	2·20	−0·260	− 884	937	0·276	53	0·016
Nov.	2·385	2·21	1·84	−0·230	− 782	854	0·251	72	0·021
Dec.	2·155	2·10	1·68	−0·200	− 680	817	0·240	137	0·040

a.—Water Levels taken at Superior, Wis., from 1860 to 1871, inclusive

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior. Marquette, Mich. a		St. Marys River. Sault Ste. Marie, Mich.						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Deptp Lake Superior.	100c.f.s.	Ft. Depth
1864									
Jan.	601·955	601·81	601·34	−0·250	− 850	739	0·217	− 111	−0·033
Feb.	1·705	1·60	1·11	−0·070	− 238	686	0·202	448	0·132
Mar.	1·635	1·67	1·18	+0·045	+ 153	702	0·206	855	0·251
Apr.	1·68	1·69	1·18	+0·090	+ 306	702	0·206	1008	0·296
May	1·77	1·85	1·48	+0·155	+ 527	771	0·227	1298	0·382
June	1·925	2·00	1·65	+0·120	+ 408	810	0·238	1218	0·358
July	2·045	2·09	1·78	+0·050	+ 170	840	0·247	1010	0·297
Aug.	2·095	2·10	1·80	+0·080	+ 272	845	0·248	1117	0·328
Sept.	2·175	2·25	1·89	−0·055	− 187	866	0·255	679	0·200
Oct.	2·12	1·99	1·63	−0·225	− 765	806	0·237	41	0·012
Nov.	1·895	1·80	1·43	−0·170	− 578	760	0·223	182	0·053
Dec.	1·725	1·65	1·23	−0·165	− 561	714	0·210	153	0·045
1865									
Jan.	1·56	1·47	1·00	−0·095	− 323	661	0·194	338	0·099
Feb.	1·465	1·46	0·97	−0·070	− 238	654	0·192	416	0·122
Mar.	1·395	1·33	0·84	+0·155	+ 527	624	0·183	1151	0·338
Apr.	1·55	1·77	1·26	+0·465	+1582	721	0·212	2303	0·677
May	2·015	2·26	1·89	+0·450	+1530	866	0·255	2396	0·705
June	2·465	2·67	2·32	+0·365	+1241	965	0·284	2206	0·649
July	2·83	2·99	2·68	+0·200	+ 680	1048	0·308	1728	0·508
Aug.	3·03	3·07	2·77	+0·045	+ 153	1068	0·314	1221	0·359
Sept.	3·075	3·08	2·72	−0 100	− 340	1057	0·311	717	0·211
Oct.	2·975	2·87	2·51	−0·370	−1258	1009	0·297	− 249	−0·073
Nov.	2·605	2·34	1·97	−0·420	−1428	884	0·260	− 544	−0·160
Dec.	2·185	2·03	1·61	−0·300	−1020	801	0·236	− 219	−0·064
1866									
Jan.	1·885	1·74	1·27	−0·250	− 850	723	0·213	− 127	−0·037
Feb.	1·635	1·53	1·04	−0·105	− 357	670	0·197	313	0·092
Mar.	1·53	1·53	1·04	+0·225	+ 765	670	0·197	1435	0·422
Apr.	1·755	1·98	1·47	+0·350	+1190	769	0·226	1959	0·576
May	2·105	2·23	1·86	+0·220	+ 748	859	0·253	1607	0·473
June	2·325	2·42	2·07	+0·240	+ 816	907	0·267	1723	0·507
July	2·565	2·71	2·40	+0·260	+ 884	983	0·289	1867	0·549
Aug.	2·825	2·94	2·64	−0·020	− 68	1038	0·305	970	0·285
Sept.	2·805	2·67	2·31	−0·125	− 425	962	0·283	537	0·158
Oct.	2·68	2·59	2·33	−0·155	− 527	967	0·284	440	0·129
Nov.	2·525	2·36	1·99	−0·110	− 374	889	0·261	515	0·151
Dec.	2·415	2·47	2·05	−0·080	− 272	903	0·266	631	0·186
1867									
Jan.	2·335	2·20	1·73	−0·190	− 646	829	0·244	183	0·054
Feb.	2·145	2·09	1·60	−0·150	− 510	799	0·235	289	0·085
Mar.	1·995	1·90	1·41	+0·015	+ 51	755	0·222	806	0·237
Apr.	2·01	2·12	1·61	+0·050	+ 170	801	0·236	971	0·286
May	2·06	2·12	1·75	+0·350	+1190	834	0·245	2024	0·595
June	2·41	2·72	2·37	+0·475	+1616	976	0·287	2592	0·762
July	2·885	3·05	2·74	+0·105	+ 357	1062	0·312	1419	0·417
Aug.	2·99	2·93	2·63	−0·020	− 68	1036	0·305	968	0·285
Sept.	2·97	3·01	2·65	+0·030	+ 102	1041	0·306	1143	0·336
Oct.	3·00	2·99	2·63	−0·225	− 765	1036	0·305	271	0·080
Nov.	2·775	2·56	2·19	−0·375	−1275	935	0·275	− 340	−0·100
Dec.	2·40	2·24	1·82	−0·240	− 816	950	0·850	34	0·010

a.—Water Levels taken at Superior, Wis., from 1860 to 1871, inclusive.

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich. *a*		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1868.									
Jan.	602·16	602·08	601·61	−0·375	−1275	801	0·236	− 474	−0·139
Feb.	1·785	1·49	1·00	−0·115	− 391	661	0·194	270	0·079
Mar.	1·67	1·85	1·36	+0·265	+ 901	744	0·219	1645	0·484
Apr.	1·945	2·04	1·53	+0·295	+1003	783	0·230	1786	0·525
May	2·24	2·44	2·07	+0·155	+ 527	907	0·267	1434	0·422
June	2·395	2·35	2·00	+0·065	+ 221	891	0·262	1112	0·327
July	2·46	2·57	2·26	+0·070	+ 238	951	0·280	1189	0·350
Aug.	2·53	2·49	2·19	+0·025	+ 85	935	0·275	1020	0·300
Sept.	2·555	2·62	2·26	+0·050	+ 170	951	0·280	1121	0·330
Oct.	2·605	2·59	2·23	+0·065	+ 221	944	0·278	1165	0·343
Nov.	2·67	2·75	2·38	−0·135	− 459	979	0·288	520	0·153
Dec.	2·535	2·32	1·90	−0·325	−1105	868	0·255	− 237	0·070
1869.									
Jan.	2·21	2·10	1·63	−0·230	− 782	806	0·237	24	0·007
Feb.	1·98	1·86	1·37	−0·345	−1173	746	0·219	− 427	−0·126
Mar.	1·635	1·41	0·92	+0·065	+ 221	642	0·189	863	0·254
Apr.	1·70	1·99	1·48	+0·490	+1666	771	0·227	2436	0·716
May	2·19	2·39	2·02	+0·205	+ 697	896	0·263	1593	0·468
June	2·395	2·40	2·05	+0·190	+ 646	903	0·266	1549	0·456
July	2·585	2·77	2·46	+0·415	+1411	997	0·293	2408	0·708
Aug.	3·00	3·23	2·93	+0·655	+2228	1105	0·325	3333	0·980
Sept.	3·655	4·08	3·72	+0·165	+ 561	1287	0·378	1848	0·543
Oct.	3·82	3·56	3·20	−0·430	−1462	1168	0·343	− 294	−0·086
Nov	3·39	3·22	2·85	−0·495	−1684	1087	0·320	− 597	−0·176
Dec.	2·895	2·57	2·15	−0·450	−1530	926	0·272	− 604	−0·178
1870.									
Jan.	2·445	2·32	1·85	−0·230	− 782	856	0·252	74	0·022
Feb.	2·215	2·11	1·62	−0·100	− 340	804	0·236	464	0·136
Mar.	2·115	2·12	1·63	+0·055	+ 187	806	0·237	993	0·292
Apr.	2·17	2·22	1·71	+0·215	+ 731	824	0·242	1555	0·457
May	2·385	2·55	2·18	+0·070	+ 238	932	0·274	1170	0·344
June	2·455	2·36	2·01	0·000	0	893	0·263	893	0·263
July	2·455	2·55	2·24	+0·095	+ 323	946	0·278	1269	0·373
Aug.	2·55	2·55	2·25	+0·085	+ 289	949	0·279	1238	0·364
Sept.	2·635	2·72	2·36	+0·005	+ 17	974	0·286	991	0·291
Oct.	2·64	2·56	2·20	−0·170	− 578	937	0·276	359	0·106
Nov.	2·47	2·38	2·01	−0·555	−1888	893	0·263	− 995	−0·293
Dec	1·915	1·45	1·03	−0·510	−1734	668	0·196	−1066	−0·313
1871.									
Jan.	1·405	1·36	1·36	−0·345	−1173	744	0·219	− 429	−0·126
Feb.	1·06	0·76	1·20	+0·410	+1394	707	0·208	2101	0·618
Mar.	1·47	1·18	0·93	−0·040	− 136	644	0·189	508	0·149
Apr.	1·43	1·68	1·07	+0·515	+1752	677	0·199	2429	0·714
May	1·945	2·21	1·64	+0·325	+1105	808	0·238	1913	0·562
June	2·27	2·33	2·05	+0·095	+ 323	903	0·266	1226	0·360
July	2·365	2·40	2·23	+0·065	+ 221	944	0·278	1165	0·343
Aug.	2·43	2·46	2·15	+0·080	+ 272	926	0·272	1198	0·352
Sept.	2·51	2·56	2·20	+0·015	+ 51	937	0·276	988	0·291
Oct.	2·525	2·49	2·00	−0·070	− 238	891	0·262	653	0·192
Nov.	2·455	2·42	1·78	−0·405	−1377	840	0·247	− 537	−0·158
Dec.	2·05	1·68	1·39	−0·475	−1616	750	0·221	− 866	−0·255

a.—Water Levels taken at Superior, Wis., from 1860 to 1871, inclusive.

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich. a		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1872.									
Jan.	601·575	601·47	601·14	−0·160	− 544	693	0·204	149	0·044
Feb.	1·415	1·36	1·06	−0·115	− 391	674	0·198	283	0·083
Mar.	1·30	1·24	0·82	−0·110	− 374	619	0·182	245	0·072
Apr.	1·19	1·14	0·78	+0·275	+ 935	610	0·179	1545	0·454
May	1·465	1·79	1·67	+0·515	+1752	815	0·240	2567	0·755
June	1·98	2·17	1·84	+0·325	+1105	854	0·251	1959	0·576
July	2·305	2·44	2·24	+0·220	+ 748	946	0·278	1694	0·498
Aug.	2·525	2·61	2·56	+0·165	+ 561	1020	0·300	1581	0·465
Sept	2·69	2·77	2·63	+0·030	+ 102	1036	0·305	1138	0·335
Oct.	2·72	2·67	2·48	−0·125	− 425	1002	0·295	577	0·170
Nov.	2·595	2·52	2·33	−0·225	− 765	967	0·284	202	0·059
Dec.	2·37	2·22	1·88	−0·200	− 680	863	0·254	183	0·054
1873.									
Jan.	2·17	2·12	1·48	−0·210	− 714	771	0·227	57	0·017
Feb.	1·96	1·80	1·31	−0·150	− 510	732	0·215	222	0·065
Mar.	1·81	1·82	1·33	+0·030	+ 102	737	0·217	839	0·247
Apr.	1·84	1·86	1·35	+0·245	+ 833	741	0·218	1574	0·463
May	2·085	2·31	1·91	+0·375	+1275	870	0·256	2145	0·631
June	2·46	2·61	2·04	+0·295	+1003	900	0·265	1903	0·560
July	2·755	2·90	2·48	+0·235	+ 799	1002	0·295	1801	0·530
Aug.	2·99	3·08	2·73	+0·120	+ 408	1059	0·311	1467	0·431
Sept.	3·11	3·14	2·80	−0·020	− 68	1075	0·316	1007	0·296
Oct.	3·09	3·04	2·68	−0·120	− 408	1048	0·308	640	0·188
Nov.	2·97	2·90	2·46	−0·220	− 748	997	0·293	249	0·073
Dec.	2·75	2·60	2·22	−0·380	−1292	942	0·277	− 350	−0·103
1874.									
Jan.	2·37	2·14	1·67	−0·235	− 799	815	0·240	16	0·005
Feb.	2·135	2·13	1·51	−0·025	− 85	778	0·229	693	0·204
Mar.	2·11	2·09	1·40	+0·030	+ 102	753	0·221	855	0·252
Apr.	2·14	2·19	1·28	+0·085	+ 289	725	0·213	1014	0·298
May	2·225	2·26	1·70	+0·135	+ 459	822	0·242	1281	0·377
June	2·36	2·46	2·13	+0·290	+ 986	921	0·271	1907	0·561
July	2·65	2·84	2·50	+0·235	+ 799	1006	0·296	1805	0·531
Aug.	2·885	2·93	2·56	+0·095	+ 323	1020	0·300	1343	0·395
Sept.	2·98	3·03	2·54	+0·080	+ 272	1016	0·299	1288	0·379
Oct.	3·06	3·09	2·67	−0·060	− 204	1045	0·307	841	0·247
Nov.	3·00	2·91	2·45	−0·245	− 833	995	0·293	162	0·048
Dec.	2·755	2·60	2·35	−0·315	−1071	972	0·286	− 99	−0·029
1875.									
Jan.	2·44	2·28	1·89	−0·180	− 612	866	0·255	254	0·075
Feb.	2·26	2·24	1·64	0·000	0	808	0·238	808	0·238
Mar.	2·26	2·28	1·60	+0·020	+ 68	799	0·235	867	0·255
Apr.	2·28	2·28	1·85	+0·110	+ 374	856	0·252	1230	0·362
May	2·39	2·50	2·16	+0·290	+ 986	928	0·273	1914	0·563
June	2·68	2·86	2·46	+0·175	+ 595	997	0·293	1592	0·468
July	2·855	2·85	2·54	+0·040	+ 136	1016	0·299	1152	0·339
Aug.	2·895	2·94	2·56	+0·160	+ 544	1020	0·300	1564	0·460
Sept	3·055	3·17	2·84	+0·040	+ 136	1085	0·319	1221	0·359
Oct.	3·095	3·02	2·71	−0·145	− 493	1055	0·310	562	0·165
Nov.	2·95	2·88	2·43	−0·170	− 578	990	0·291	412	0·121
Dec.	2·78	2·68	1·87	−0·200	− 680	861	0·253	181	0·053

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior. Marquette, Mich.		St. Marys River. Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior:	100 c.f.s.	Ft. Depth
1876									
Jan.	602·58	602·48	601·48	−0·205	−697	854	0·251	157	0·046
Feb.	2·375	2·27	1·79	−0·150	−510	843	0·248	333	0·098
Mar.	2,225	2·18	1·53	−0·030	−102	783	0·230	681	0·200
Apr.	2·195	2·21	1·57	+0·285	+969	792	0·233	1761	0·518
May.	2·48	2·75	2·29	+0·610	+2075	958	0·282	3033	0·892
June.	3·09	3·43	2·87	+0·535	+1820	1092	0·321	2912	0·856
July.	3·625	3·82	3·34	+0·250	+ 850	1200	0·353	2050	0·603
Aug.	3·875	3·93	3·39	0·000	0	1211	0·356	1211	0·356
Sept.	3·875	3·82	3·42	−0·220	−748	1218	0·358	470	0·138
Oct.	3·655	3·49	3·09	−0·245	− 833	1142	0·336	309	0·091
Nov.	3·41	3·33	3·81	−0·220	− 748	1078	0·317	330	0·097
Dec.	3·19	3·05	2·32	−0·320	−1088	965	0·284	− 123	−0·036
1877									
Jan.	2·87	2·69	2·03	−0·300	−1020	898	0·264	− 122	−0·036
Feb.	2·57	2·45	2·06	−0·250	− 850	905	0·266	55	0·016
Mar.	2·32	2·19	1·94	0·170	− 578	877	0·258	299	0·088
Apr.	2·15	2·11	1·82	−0·045	− 153	850	0·250	697	0·205
May.	2·105	2·10	1·82	+0·105	+ 357	850	0·250	1207	0·355
June.	2·21	2·32	2·04	+0·300	+1020	900	0·265	1920	0·565
July.	2·51	2·70	2·37	+0·220	+ 748	976	0·287	1724	0 507
Aug.	2·73	2·76	2·49	−0·050	− 170	1004	0·295	834	0·245
Sept.	2·68	2·60	2·25	−0·080	− 272	949	0·279	677	0·199
Oct.	2·60	2·69	2·29	−0·105	− 357	958	0·282	601	0·177
Nov.	2·495	2·39	2·05	−0·140	− 476	903	0·266	427	0·126
Dec.	2·355	2·32	1·89	−0·095	− 323	866	0·255	543	0·160
1878									
Jan.	2·26	2·20	1·67	0·000	0	815	0·240	815	0·240
Feb.	2·26	2·32	1·41	−0·325	−1105	755	0·222	− 350	−0·103
Mar.	1·935	1·55	1,31	−0·400	−1360	732	0·215	− 628	−0·185
Apr.	1·535	1·52	1·29	+0·120	+ 408	728	0·214	1136	0·334
May.	1·655	1·79	1·57	+0·275	+ 935	792	0·233	1727	0·508
June.	1·93	2·07	1·83	−0·175	+ 595	852	0·251	1447	0·425
July.	2·105	2·14	1·94	−0·025	− 85	877	0·258	792	0·233
Aug.	2·08	2·02	1·90	−0·145	− 493	868	0·255	375	0·110
Sept.	1·935	1·85	1·61	−0·050	− 170	801	0·236	631	0·186
Oct.	1·885	1·92	1·72	−0·065	− 221	826	0·243	605	0·178
Nov.	1·82	1·72	1·64	−0·260	− 884	808	0·238	− 76	−0·022
Dec.	1·56	1·40	1·42	−0·115	− 391	757	0·223	366	0·108
1879									
Jan.	1·445	1·49	1·02	+0·030	+ 102	665	0·196	767	0·226
Feb.	1·475	1·46	0·62	+0·135	+ 459	573	0·168	1032	0·303
Mar.	1·61	1·76	0·38	−0·045	− 153	518	0·152	365	0·107
Apr.	1·565	1·37	0·51	−0·375	−1275	548	0·161	− 727	−0·214
May.	1·19	1·01	0·88	−0·065	− 221	633	0·186	412	0·121
June.	1·125	1·24	1·02	+0·235	+ 799	665	0·196	1464	0·431
July.	1·36	1·48	1·32	+0·180	+ 612	734	0·216	1346	0·396
Aug.	1·54	1·60	1·35	+0·005	+ 17	741	0·218	758	0·223
Sept	1·545	1·49	1·27	−0·010	− 34	723	0·213	689	0·203
Oct.	1·535	1·58	1·30	+0·005	+ 17	730	0·215	747	0·220
Nov.	1·54	1·50	1·12	−0·220	− 748	688	0·202	− 60	−0·018
Dec.	1·32	1·14	0·72	−0·255	− 867	596	0·175	− 271	−0·080

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	WATER LEVELS OF—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich.		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1880									
Jan.	601·065	600·99	600·52	−0·080	− 272	550	0·162	278	0·082
Feb.	0·985	0·98	0·49	−0·050	− 170	543	0·160	373	0·110
Mar.	0·935	0·89	0·40	+0·470	+1598	522	0·153	2120	0·623
Apr.	1·405	1·92	0·41	+0·315	+1071	525	0·154	1596	0·469
May.	1·72	1·52	1·15	+0·190	+ 646	695	0·204	1341	0·394
June.	1·91	2·30	1·91	+0·465	−1582	870	0·246	2452	0·721
July.	2·375	2·45	2·15	+0·070	+ 238	926	0·272	1164	0·342
Aug.	2·445	2·44	2·03	−0·005	− 17	898	0·264	881	0·259
Sept.	2·44	2·44	2·19	−0·025	− 85	935	0·275	850	0·250
Oct.	2·415	2·39	1·96	−0·055	− 187	882	0·259	695	0·204
Nov.	2·36	2·33	1·99	−0·160	− 544	889	0·261	345	0·101
Dec.	2·20	2·07	1·71	−0·260	− 884	824	0·242	− 60	−0·018
1881									
Jan.	1·94	1·81	1·40	−0·180	− 612	753	0·221	141	0·041
Feb.	1·76	1·71	1·30	−0·095	− 323	730	0·215	407	0·120
Mar.	1·665	1·62	1·32	−0·090	− 306	734	0·216	428	0·126
Apr.	1·575	1·53	1·21	+0·015	− 357	709	0·208	10·66	0·313
May.	1·68	1·83	1·63	+0·370	+1258	806	0·237	20·64	0·607
June.	2·05	2·27	1·86	+0·250	+ 850	859	0·253	1709	0·503
July.	2·30	2·33	2·06	+0·055	+ 187	905	0·266	1092	0·321
Aug.	2·355	2·38	1·98	+0·140	− 476	886	0·260	1362	0·400
Sept.	2·495	2·61	2·17	+0·285	+ 969	930	0·273	1899	0·558
Oct..	2·78	2·95	2·63	+0·135	+ 459	1036	0·305	1495	0·440
Nov.	2·915	2·88	2·53	−0·175	− 595	1013	0·298	418	0·123
Dec.	2·74	2·60	2·20	−0·135	−1071	937	0·276	− 134	−0·039
1882									
Jan.	2·425	2·25	1·69	−0·300	−1020	820	0·241	− 200	—0·059
Feb.	2·215	2·00	1·47	−0·180	− 612	769	0·226	157	0·046
Mar.	1·945	1·89	1·35	−0·095	− 323	741	0·218	418	0·123
Apr.	1·85	1·81	1·30	+0·040	+ 136	730	0·215	866	0·255
May.	1·89	1·97	1·71	+0·090	+ 306	824	0·242	1130	0·332
June.	1·98	1·99	1·80	+0·235	+ 799	845	0·248	1644	0·483
July.	2·125	2·44	2·15	+0·285	+ 969	926	0·272	1895	0·557
Aug.	2·50	2·56	2·25	+0·080	+ 272	949	0·279	1221	0·359
Sept.	2·58	2·60	2·19	−0·065	− 221	936	0·275	714	0·210
Oct.	2·515	2·43	2·10	−0·095	− 323	914	0·269	591	0·174
Nov.	2·42	2·41	2·04	−0·105	− 357	900	0·265	543	0·160
Dec.	2·315	2·22	1·77	−0·210	− 714	838	0·246	124	0·036
1883									
Jan.	2·105	1·99	1·34	−0·260	− 884	739	0·217	− 145	−0·043
Feb.	1·845	1·70	1·25	−0·145	− 493	718	0·211	225	0·066
Mar.	1·70	1·70	1·25	+0·125	+ 425	718	0·216	1143	0·336
Apr.	1·825	1·95	1·32	+0·130	+ 442	734	0·215	1176	0·346
May.	1·955	1·96	1·31	+0·055	+ 187	732	0·215	919	0·270
June.	2·01	2·06	1·68	+0·175	+ 595	817	0·240	1412	0·415
July.	2·185	2·31	1·86	+0·135	+ 459	859	0·253	1318	0·388
Aug.	2·32	2·33	2·28	−0·010	− 34	956	0·281	922	0·271
Sept.	2·31	2·29	1·95	−0·120	− 408	880	0·259	472	0·139
Oct.	2·19	2·09	1·80	−0·175	− 595	845	9·248	250	0·073
Nov.	2·015	1·94	1·69	−0·130	− 442	820	0·241	378	0·111
Dec.	1·885	1·83	1·43	−0·070	− 238	760	0·223	522	0·153

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich. a		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1884									
Jan.	601·815	601·80	601·33	−0·100	− 340	737	0·217	397	0·117
Feb.	1·715	1·63	1·14	−0·130	− 442	693	0·204	251	0·074
Mar.	1·585	1·54	1·05	−0·155	− 527	672	0·198	145	0·043
Apr.	1·43	1·32	0·88	0·000	0	633	0·186	633	0·186
May	1·43	1·54	1·25	+0·210	+ 714	718	0·211	1432	0·421
June	1·64	1·74	1·35	+0·170	+ 578	741	0·218	1319	0·388
July	1·81	1·88	1·57	+0·075	+ 255	792	0·233	1047	0·308
Aug.	1·785	1·89	1·61	+0·140	+ 476	801	0·236	1277	0·375
Sept.	2·025	2·16	1·68	+0·315	+1071	817	0,240	1888	0,555
Oct.	2·34	2·52	1·77	+0·130	+ 442	838	0·246	1280	0·376
Nov.	2·47	2·42	1·87	−0·155	− 527	861	0·253	334	0·098
Dec.	2·315	2·21	1·61	−0·220	− 748	801	0·236	53	0,016
1885									
Jan.	2·095	1·98	1·44	−0,205	− 697	762	0·224	65	0,019
Feb.	1·89	1·80	1·33	−0·130	− 442	737	0·217	295	0·087
Mar.	1·76	1·72	1·19	−0·065	− 221	704	0·207	483	0·142
Apr.	1·695	1·67	1·02	+0·140	+ 476	665	0·196	1141	0·336
May	1·835	2·00	1·60	+0·305	+1037	799	0·235	1836	0·540
June	2·14	2·28	1·94	+0·260	+ 884	877	0,258	1761	0·518
July.	2·40	2·52	2·12	+0·180	+ 612	919	0·270	1531	0·450
Aug.	2·58	2·64	2·34	+0·025	+ 85	969	0·285	1054	0·310
Sept.	2·605	2·57	2·10	−0·120	− 408	914	0·269	506	0·149
Oct.	2·485	2·40	1·92	−0·160	− 544	873	0·257	239	0·097
Nov.	2·325	2·25	1·85	−0·240	− 816	856	0·252	40	0·012
Dec.	2·085	1·92	1·55	−0·265	− 901	787	0·231	− 114	−0·034
1886									
Jan.	1·82	1·72	1·20	−0·165	− 561	707	0·208	146	0·043
Feb.	1·655	1·59	1·04	−0·095	− 323	670	0·197	347	0·102
Mar.	1·56	1·53	1·04	+0,015	+ 51	670	0·197	721	0·212
Apr.	1·575	1·62	1·02	+0·170	+ 578	665	0·196	1243	0·365
May.	1·745	1·87	1·50	+0·195	+ 663	776	0·228	1439	0·423
June	1·94	2·01	1·66	+0·105	− 357	813	0·239	1170	0,344
July	2·045	2·08	1·83	−0·010	− 34	852	0·251	818	0·241
Aug.	2·035	1·99	1·97	−0·055	− 187	884	0·260	697	0·205
Sept.	1·98	1·97	1·83	−0·040	− 136	852	0·251	988	0·291
Oct.	2·02	2·07	1·86	−0·025	− 85	859	0·253	774	0·228
Nov.	1·995	1·92	1·79	−0·145	− 493	843	0·248	350	0·103
Dec.	1·85	1·78	1·36	−0·225	− 765	744	0·219	− 21	−0·006
1887									
Jan.	1·625	1·47	1·14	−0·145	− 493	693	0·204	200	0·059
Feb.	1·48	1·49	1·00	−0·165	+ 561	661	0·194	1222	0·359
Mar.	1·645	1·80	0·97	−0·240	+ 816	654	0·192	1470	0·432
Apr.	1·885	1·97	0·83	−0·020	− 68	622	0·183	554	0·163
May	1·865	1·76	1·19	−0·025	− 85	704	0·207	619	0·182
June	1·84	1·92	1·64	+0·220	+ 748	808	0·238	1556	0·458
July.	2·06	2·20	2·01	+0·180	+ 612	893	0·263	1505	0·443
Aug.	2·24	2·28	1·89	−0·030	− 102	866	0·255	764	0·225
Sept.	2·21	2·14	1·75	−0·105	− 357	834	0·245	477	0·140
Oct.	2·105	2·07	1·93	−0·155	− 527	875	0·257	348	0·102
Nov.	1·95	1·83	1·70	−0·230	− 782	822	0·242	40	0·012
Dec.	1·72	1·61	1·29	−0·165	− 561	728	0·214	167	0·049

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich. a		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1888									
Jan.	601·555	601·50	601·13	−0·050	− 170	691	0·203	521	0·153
Feb.	1·505	1·51	0·79	−0·030	− 102	612	0·180	510	0·150
Mar.	1·475	1·44	0·84	−0·035	− 119	624	0·183	505	0·148
Apr.	1·44	1·44	0·83	+0·235	+ 799	622	0·183	1421	0·418
May	1·675	1·91	1·43	+0·625	+2126	760	0·223	2886	0·849
June	2·30	2·69	2·28	+0·485	+1650	956	0·281	2606	0·766
July	2·785	2·88	2·44	+0·165	+ 561	992	0·292	1553	0·457
Aug.	2·95	3·02	2·43	+0·045	+ 153	990	0·291	1143	0·336
Sept.	2·995	2·97	2·35	−0·070	− 238	972	0·286	734	0·216
Oct.	2·925	2·88	2·34	−0·115	− 391	969	0·285	578	0·170
Nov.	2·81	2·74	2·14	−0·245	− 833	923	0·271	90	0·026
Dec.	2·565	2·39	1·80	−0·335	−1139	778	0·229	− 361	−0·106
1889									
Jan.	2·23	2·07	1·52	−0·270	− 918	722	0·212	− 196	−0·058
Feb.	1·96	1·85	1·23	−0·195	− 663	664	0·195	1	0·000
Mar.	1·765	1·68	1·26	−0·080	− 272	670	0·197	398	0·117
Apr.	1·685	1·69	1·25	−0·180	+ 612	668	0,196	1280	0·376
May	1·865	2·04	1·81	+0·235	+ 799	780	0·229	1579	0·464
June	2·10	2·16	1·99	+0·155	+ 527	816	0·240	1343	0·395
July	2·255	2·35	2·26	+0·190	+ 646	870	0·256	1516	0·446
Aug.	2·445	2·54	2·27	+0·160	+ 544	872	0·256	1416	0·416
Sept.	2·605	2·67	2·26	−0·015	− 51	870	0·256	819	0·241
Oct.	2·59	2·51	2·11	−0·235	− 799	840	0·247	41	0·012
Nov.	2·355	2·20	1·81	−0·305	−1027	780	0·229	− 257	−0·076
Dec.	2·005	1·90	1·43	−0·220	− 748	704	0·207	− 44	−0·013
1890									
Jan.	1·83	1·76	1·48	−0·1 5	− 459	714	0·210	255	0·075
Feb.	1·695	1·63	0·93	−0·185	− 629	604	0·178	− 25	−0·007
Mar.	1·51	1·39	0·92	−0·185	− 459	602	0·177	140	0·042
Apr..	1·375	1·36	0·85	+0·090	− 306	588	0·173	894	0·263
May.	1·465	1·57	1·32	+0·330	+1122	682	0·201	1804	0·530
June	1·795	2·02	1·90	+0·375	+1275	798	0·235	2073	0·610
July.	2·17	2·32	2·26	+0·225	+ 765	870	0,256	1635	0·481
Aug.	2·395	2·47	2·17	+0·140	+ 476	852	0·251	1328	0·390
Sept.	2·535	2·60	2·06	+0·050	+ 170	830	0·244	1000	0·294
Oct.	2·585	2·57	1·99	−0·120	− 408	816	0·240	408	0·120
Nov	2·465	2·36	1·85	−0·285	− 969	878	0·232	− 181	0·053
Dec.	2·18	2·00	1·55	−0·360	−1224	728	0·214	− 496	−0·146
1891									
Jan.	1·82	1·64	0·86	−0·245	− 833	590	0·173	− 243	−0·071
Feb.	1·575	1·51	0·97	−0·085	− 289	612	0·180	323	0·095
Mar.	1·49	1·47	0·82	−0·040	− 136	582	0·171	446	0·131
Apr.	1·45	1·43	1·00	+0·080	+ 272	618	0·182	890	0·262
May.	1·53	1·63	1·43	+0·125	+ 425	704	0·207	1129	0·332
June	1·655	1·68	1·38	+0·125	+ 425	694	0·204	1119	0·329
July	1·78	1·88	1·49	+0·090	+ 306	716	0·211	1022	0·301
Aug.	1·87	1·86	1·50	−0·030	− 102	718	0·211	616	0·181
Sept.	1·84	1·82	1·43	+0·025	+ 85	704	0·207	789	0·232
Oct.	1·865	1·91	1·49	−0·015	− 51	716	0·211	665	0·196
Nov.	1·85	1·79	1·38	−0·245	− 833	694	0·204	− 139	−0·041
Dec.	1·605	1·42	1·07	−0·185	− 629	632	0·186	3	0·001

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich.		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1892									
Jan.	601·42	601·42	601·01	−0·140	− 476	620	0·182	144	0·042
Feb.	1·28	1·14	0·65	−0·205	− 697	548	0·161	− 149	−0·044
Mar.	1·075	1·01	0·47	−0·060	− 204	512	0·151	308	0·091
Apr.	1·015	1·02	0·63	+0·170	+ 578	544	0·160	1122	0·330
May	1·185	1·35	1·14	+0·355	+1207	646	0·190	1853	0·545
June	1·54	1·73	1·50	+0·205	+ 697	718	0·211	1415	0·416
July	1·745	1·76	1·64	+0·075	+ 255	746	0·219	1001	0·294
Aug.	1·82	1·88	1·65	+0·085	+ 289	748	0·220	1037	0·305
Sept.	1·905	1·93	1·71	−0·025	− 85	760	0·223	675	0·198
Oct.	1·88	1·83	1·60	−0·135	− 459	738	0·217	279	0·082
Nov.	1·745	1·66	1·32	−0·225	− 765	682	0·201	− 83	−0·024
Dec.	1·52	1·38	1·04	−0·280	− 952	626	0·184	− 326	−0·096
1893									
Jan.	1·24	1·10	0·79	−0·185	− 629	519	0·153	− 110	−0·032
Feb.	1·055	1·01	0·59	−0·020	− 68	482	0·142	414	0·122
Mar.	1·035	1·06	0·60	+0·075	+ 255	484	0·142	739	0·217
Apr.	1·11	1·16	0·85	+0·300	+1020	531	0·156	1551	0·456
May	1·41	1·66	1·42	+0·510	+1734	638	0·188	2372	0·698
June	1·92	2·18	1·95	+0·410	+1394	738	0·217	2132	0·627
July	2·33	2·48	2·15	+0·180	+ 612	775	0·228	1387	0·408
Aug.	2·51	2·54	2·23	−0·015	− 51	790	0·232	739	0·217
Sept.	2·495	2·45	2·10	−0·060	− 204	766	0·225	562	0·165
Oct.	2·435	2·42	2·04	−0·095	− 323	755	0·222	432	0·127
Nov.	2·34	2·26	1·99	−0·195	− 663	745	0·219	82	0·024
Dec.	2·145	2·03	1·45	−0·195	− 663	644	0·189	− 19	−0·006
1894									
Jan.	1·94	1·85	1·23	−0·180	− 612	602	0·177	− 10	−0·003
Feb.	1·76	1·67	1·15	−0·045	− 153	587	0·173	434	0·128
Mar.	1·715	1·76	1·04	+0·120	+ 408	566	0·166	974	0·286
Apr.	1·835	1·91	1·42	+0·465	+1582	638	0·188	2220	0·653
May	2·30	2·69	2·40	+0·500	+1700	822	0·242	2522	0·742
June	2·80	2·91	2·64	+0·140	+ 476	868	0·255	1344	0·395
July	2·94	2·97	2·78	+0·095	+ 323	894	0·263	1217	0·358
Aug.	3·035	3·10	2·79	+0·025	+ 85	896	0·263	981	0·288
Sept.	3·06	3·02	2·66	−0·030	− 102	871	0·256	769	0·226
Oct.	3·03	3·04	2·70	−0·015	− 51	879	0·258	828	0·243
Nov.	3·015	2·99	2·60	−0·120	− 408	860	0·253	452	0·133
Dec.	2·895	2·80	2·30	−0·245	− 833	804	0·236	− 29	−0·009
1895									
Jan.	2·65	2·50	2·00	−0·260	− 884	747	0·220	− 137	−0·040
Feb.	2·39	2·28	1·86	−0·195	− 663	721	0·212	58	0·017
Mar.	2·195	2·11	1·66	−0·135	− 459	683	0·201	224	0·066
Apr.	2·06	2·01	1·64	+0·135	+ 459	679	0·200	1138	0·335
May	2·195	2·38	2·04	+0·345	+1173	755	0·222	1928	0·567
June	2·54	2·70	2·43	+0·260	+ 884	828	0·243	1712	0·503
July	2·80	2·90	2·67	+0·125	+ 425	873	0·257	1298	0·382
Aug.	2·925	2·95	2·68	+0·095	+ 323	875	0·257	1198	0·352
Sept.	3·02	3·09	2·85	+0·095	+ 323	907	0·267	1230	0·362
Oct.	3·115	3·14	2·97	−0·120	− 408	930	0·273	522	0·153
Nov.	2·995	2·85	2·45	−0·310	−1054	832	0·245	− 222	−0·065
Dec.	2·685	2·52	2·24	−0·265	− 901	830	0·214	− 71	−0·021

TABLE 24—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich.		Sault Ste. Marie, Mich						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1896									
Jan.	602·42	602·32	601·69	−0·200	− 680	727	0·214	47	0·014
Feb.	2·22	2·12	1·68	−0·200	− 680	687	0·202	7	0·002
Mar.	2·02	1·92	1·48	−0·055	− 187	649	0·191	462	0·136
Apr.	1·965	2·01	1·57	+0·370	+1258	701	0·206	1959	0·576
May	2·335	2·66	2·18	+0·515	+1752	816	0·240	2568	0·755
June	2·85	3·04	2·59	+0·220	+ 748	893	0·263	1641	0·483
July	3·07	3·10	2·72	+0·040	+ 136	918	0·270	1054	0·310
Aug.	3·11	3·12	2·74	−0·075	− 255	921	0·271	666	0·196
Sept.	3·035	2·95	2·61	−0·245	− 833	897	0·264	64	0·019
Oct.	2·79	2·63	2·18	−0·125	− 425	816	0·240	391	0·115
Nov.	2·665	2·70	2·21	−0·040	− 136	822	0·242	686	0·202
Dec.	2·625	2·55	2·15	−0·155	− 527	810	0·238	283	0·083
1897									
Jan.	2·47	2·39	1·92	−0·195	− 663	767	0·226	104	0·031
Feb.	2·275	2·16	1·61	−0·155	− 527	709	0·208	182	0·053
Mar.	2·12	2·08	1·63	−0·025	− 85	712	0·209	627	0·184
Apr.	2·095	2·11	1·76	+0·185	+ 629	737	0·217	1366	0·402
May	2·28	2·45	2·11	+0·335	+1139	803	0·236	1942	0·571
June	2·615	2·78	2·47	+0·315	+1071	871	0·256	1942	0·571
July	2·93	3·08	2·69	+0·210	+ 714	912	0·268	1626	0·478
Aug.	3·14	3·20	2·85	+0·030	+ 102	942	0·277	1044	0·307
Sept.	3·17	3·14	2·68	−0·130	− 442	910	0·268	468	0·138
Oct.	3·04	2·94	2·47	−0·250	− 850	871	0·256	21	0·006
Nov.	2·79	2·64	2·36	−0·365	−1241	850	0·250	− 391	−0·115
Dec.	2·425	2·21	1·87	−0·405	−1377	758	0·223	− 619	−0·182
1898									
Jan.	2·02	1·83	1·38	−0·280	− 952	670	0·197	− 282	−0·083
Feb.	1·74	1·65	1·15	−0·185	− 629	627	0·184	− 2	−0·001
Mar.	1·555	1·46	1·00	−0·095	− 323	599	0·176	276	0·081
Apr.	1·46	1·46	1·13	+0·120	+ 408	623	0·183	1031	0·303
May	1·58	1·70	1·42	+0·360	+1224	678	0·199	1902	0·559
June	1·94	2·18	1·83	+0·445	+1513	755	0·222	2268	0·667
July	2·385	2·59	2·17	+0·270	+ 918	819	0·241	1737	0·511
Aug.	2·655	2·72	2·28	+0·115	+ 391	841	0·247	1232	0·362
Sept.	2·77	2·82	2·42	+0·020	+ 68	866	0·255	934	0·275
Oct.	2·79	2·76	2·26	−0·130	− 442	836	0·246	394	0·116
Nov.	2·66	2·56	2·09	−0·215	− 731	804	0·236	73	0·021
Dec.	2·445	2·33	2·01	−0·300	−1020	789	0.232	231	−0·068
1899									
Jan.	2·145	1·96	1·53	−0·285	− 969	699	0·206	− 270	−0·079
Feb.	1·86	1·76	1·37	−0·085	− 289	668	0·196	379	0·111
Mar.	1·775	1·79	1·26	0·000	0	648	0·191	648	0·191
Apr.	1·775	1·76	1·26	+0·340	+1156	657	0·193	1813	0·533
May	2·115	2·47	2·12	+0·600	+2041	819	0·241	2860	0·841
June	2·715	2·96	2·56	+0·360	+1224	902	0·265	2126	0·625
July	3·075	3·19	2·76	+0·195	+ 663	940	0·276	1603	0·471
Aug.	3·27	3·35	2·91	+0·160	+ 544	968	0·285	1512	0·445
Sept.	3·43	3·51	3·10	−0·015	− 51	1001	0·295	953	0·280
Oct.	3·415	3·32	2·77	−0·150	− 510	942	0·277	432	0·127
Nov.	3·265	3·21	2·69	−0·160	− 544	926	0·272	382	0·112
Dec.	3·105	3·00	2·64	−0·290	− 986	917	0·270	− 69	−0·020

TABLE 21.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich. a		Sault Ste. Marie, Mich.						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1900									
Jan.	602·815	602·63	602·03	−0·275	− 935	793	0·233	− 142	−0·042
Feb.	2·54	2·45	1·90	−0·200	− 680	770	0·226	90	0·026
Mar.	2·34	2·23	1·64	−0·160	− 544	723	0·213	179	0·053
Apr.	2·18	2·13	1·68	+0·035	+ 119	730	0·215	849	0·250
May	2·215	2·30	1·87	−0·115	+ 391	764	0·225	1155	0·340
June	2·33	2·36	1·94	+0·140	+ 476	777	0·228	1253	0·368
July	2·47	2·58	2·17	+0·290	+ 986	818	0·241	1804	0·530
Aug.	2·76	2·94	2·39	+0·440	+1496	857	0·252	2353	0·692
Sept.	3·20	3·46	2·90	+0·300	+1020	948	0·279	1968	0·579
Oct.	3·50	3·54	2·93	+0·025	+ 85	954	0·280	1039	0·305
Nov.	3·525	3·51	3·04	+0·205	− 697	974	0·286	277	0·081
Dec.	3·23	3·13	2·63	−0·365	−1241	900	0·265	− 341	−0·100
1901									
Jan.	2·955	2·78	2·17	+0·325	−1105	818	0·241	− 287	−0·084
Feb.	2·63	2·48	1·87	−0·250	− 850	764	0·225	− 86	−0·025
Mar.	2·38	2·28	1·65	−0·130	− 442	725	0·213	283	0·083
Apr.	2·25	2·22	1·76	+0·115	+ 391	745	0·219	1136	0·334
May.	2·365	2·51	2·06	+0·195	+ 663	798	0·235	1461	0·430
June	2·56	2·61	2·15	+0·290	+ 986	814	0·239	1800	0·529
July	2·85	3·09	2·56	+0·305	+1037	888	0·261	1925	0·566
Aug.	3·155	3·22	2·74	+0·025	+ 85	920	0·290	835	0·246
Sept.	3·13	3·04	2·60	−0·075	− 255	895	0·263	640	0·188
Oct.	3·055	3·07	2·72	−0·200	− 68	798	0·235	730	0·215
Nov.	3·035	3·00	2·66	−0·195	− 663	788	0·232	125	0·037
Dec.	2·84	2·68	3·27	−0·340	−1156	728	0·214	− 428	−0·126
1902									
Jan.	2·50	2·32	1·90	−0·285	− 969	670	0·197	− 299	−0·088
Feb.	2·215	2·11	1·61	—0·175	− 595	625	0·184	30	0·009
Mar.	2·04	1·97	1·53	—0·045	− 153	613	0·180	460	0·135
Apr.	1·995	2·02	1·69	+0·185	+ 629	638	0·188	1267	0·373
May	2·18	2·34	1·88	+0·310	+1054	667	0·196	1721	0·506
June	2·49	2·64	2·25	+0·270	+ 918	725	0·213	1643	0·483
July	2·76	2·88	2·48	+0·125	+ 425	760	0·223	1185	0·348
Aug.	2·885	2·89	2·49	+0·025	+ 85	762	0·224	847	0·249
Sept.	2·91	2·93	2·54	−0·040	− 136	770	0·226	634	0·186
Oct.	2·87	2·81	2·39	−0·060	− 204	746	0·219	542	0·159
Nov.	2·81	2·81	2·46	−0·115	− 391	757	0·223	366	0·108
Dec.	2·695	2·58	2·29	−0·285	− 969	731	0·215	−238	−0·070
1903									
Jan.	2·41	2·24	1·83	−0·300	−1020	660	0·194	− 360	−0·106
Feb.	2·11	1·98	1·60	−0·180	− 612	624	0·183	12	0·003
Mar.	1·93	1·88	1·51	+0·045	+ 153	610	0·179	763	0·224
Apr.	1·975	2·07	1·76	+0·340	+1156	649	0·191	1805	0·531
May	2·315	2·56	2·15	+0·345	+1479	709	0·208	2188	0·643
June	2·75	2·94	2·57	+0·290	+ 986	774	0·228	1760	0·518
July.	3·04	3·14	2·70	+0·155	+ 527	795	0·234	1322	0·389
Aug.	3·195	3·25	2·80	+0·065	+ 221	0·810	0·238	1031	0·303
Sept.	3·26	3·27	2·82	+0·075	+ 255	813	0·239	1068	0·314
Oct.	3·335	3·40	2·98	−0·045	− 153	838	0·246	685	0·201
Nov.	2·39	3·18	2·85	−0·300	−1020	818	0·241	— 202	−0·059
Dec.	2·99	2·80	2·41	−0·340	−1156	750	0·221	− ·406	−0·119

TABLE 24.—Continued.

SUPPLY FACTORS OF LAKE SUPERIOR.

Date	Water Levels of—			Storage in Lake Superior.		Outflow through St. Marys River.		Total Supply to Lake Superior.	
	Lake Superior.		St. Marys River.						
	Marquette, Mich.		Sault Ste. Marie, Mich.						
	First of Month	Mean of Month	Mean of Month	Ft. Depth	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Superior.	100 c.f.s.	Ft. Depth
1904									
Jan.	602·65	602·50	601·87	−0·235	− 799	666	0·196	− 133	−0·039
Feb.	2·445	2·33	1·64	−0·135	− 459	630	0·185	171	0·050
Mar.	2·28	2·23	1·40	−0·080	− 272	593	0·174	321	0·094
Apr.	2·20	2·17	1·76	+0·120	+ 408	649	0·191	1057	0·311
May	2·32	2·47	2·09	+0·300	+1020	700	0·206	1720	0·506
June	2·62	2·77	2·34	+0·195	+ 663	739	0·217	1402	0·412
July	2·815	2·86	2·48	+0·090	+ 306	760	0·223	1066	0·313
Aug.	2·905	2·95	2·55	+0·110	+ 374	771	0·227	1145	0·337
Sept	3·051	3·08	2·65	+0·155	+ 527	787	0·231	1321	0·386
Oct	3·17	3·26	2·82	+0·055	+ 178	813	0·239	1000	0·294
Nov.	3·225	3·19	2·71	−0·260	− 884	796	0·234	− 88	−0·026
Dec.	2·965	2·74	2·30	−0·360	−1224	732	0·215	− 492	−0·145
1905									
Jan.	2·605	2·47	2·00	−0·305	−1·037	788	0·232	− 249	−0·073
Feb.	2·30	2·13	1·59	−0·215	− 731	712	0·209	− 19	−0·001
Mar.	2·085	2·04	1·36	+0·060	+ 204	670	0·197	874	0·257
Apr.	2·145	2·25	1·78	+0·225	+ 765	747	0·220	1512	0·445
May.	2·37	2·49	2·07	+0·210	+ 714	801	0·236	1515	0·445
June	2·58	2·67	2·25	+0·240	+ 816	834	0·245	1650	0·485
July.	2·82	2·97	2·60	+0·215	+ 731	899	0·264	1630	0·479
Aug.	3·035	3·10	2·73	+0·175	+ 595	923	0·271	1518	0·446
Sept.	3·21	3·32	2·92	+0·115	+ 391	958	0·282	1349	0·397
Oct.	3·325	3·33	2·96	−0·075	− 225	965	0·284	710	0·209
Nov.	3·25	3·17	2·73	−0·185	− 629	923	0·271	294	0·086
Dec.	3·065	2·96	2·52	−0·225	− 765	884	0·260	119	0·035
1906									
Jan.	2·84	2·72	2·18	−0·265	− 901	821	0·241	− 80	−0·024
Feb.	2·575	2·43	1·85	+0·250	− 850	760	0·223	− 90	−0·026
Mar.	2·325	2·22	1·63	− ·0140	− 476	720	0·212	244	0·072
Apr.	2·185	2·15	1·70	+0·130	+ 442	733	0·216	1175	0·346
May.	2·315	2·48	2·02	+0·315	+1071	792	0·233	1863	0·548
June	2·63	2·78	2·30	+0·210	+ 714	843	0·248	1557	0·458
July	2·84	2·90	2·50	+0·075	+ 255	880	0·259	1135	0·334
Aug.	2·915	2·93	2·46	+ ·0025	+ 85	873	0·257	958	0·282
Sept.	2·94	2·95	2·46	−0·045	− 153	873	0·257	720	0·212
Oct.	2·895	2·84	2·36	−0·145	− 493	855	0·251	362	0·106
Nov.	2·75	2·66	2·19	−0·195	− 663	823	0·242	160	0·047
Dec.	2·555	2·45	1·95	−0·220	− 748	779	0·229	31	0·009
1907									
Jan.	2·335	2·22	1·62	−0·195	− 663	718	0·211	55	0·016
Feb.	2·14	2·06	1·43	−0·140	− 476	683	0·201	207	0·061
Mar.	2·00	1·94	1·34	−0·060	− 204	666	0·196	462	0·136
Apr.	1·94	1·94	1·59	+0·080	+ 272	712	0·209	984	0·289
May	2·02	2·10	1·71	+0·305	+1037	734	0·216	1771	0·521
June	2·325	2·55	2·12	+0·300	+1020	810	0·238	1830	0·538
July	2·625	2·70	2·33	+0·190	+ 646	849	0·250	1495	0·440
Aug.	2·815	2·93	2·50	+0·235	+ 799	880	0·259	1679	0·494
Sept.	3·05	3·17	2·70	+0·110	+ 374	917	0·270	1291	0·380
Oct.	3·16	3·15	2·71	−0·145	− 493	919	0·270	426	0·125
Nov.	3·015	2·88	2·56	−0·310	−1054	891	0·262	− 163	−0·048
Dec.	2·705	2·53	2·08			803	0·236		

TABLE 25. SUPPLY FACTORS OF

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. Ft. Depth Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1860									
Jan.....		575·92	573·48			582·51	582·83	582·67	
Feb....	575·22	4·51	3·12	—0·14	—0·002	2·69	2·78	2·735	582·702
Mar....	5·08	5·64	3·54	+0·86	+0·010	2·72	2·92	2·82	2·778
Apr.. .	5·94	6·24	4·19	+0·52	+0·006	2·85	2·89	2·87	2·845
May....	6·46	6·69	4·49	+0·30	+0·003	2·97	2·94	2·955	2·912
June....	6·76	6·84	4·45	—0·26	—0·003	3·09	3·18	3·135	3·045
July....	6·50	6·17	4·20	—0·38	—0·004	3·13	3·27	3·20	3·168
Aug....	6·12	6·08	4·08	—0·26	—0·003	2·94	3·19	3·065	3·132
Sept.. .	5·86	5·65	3·68	+0·12	+0·001	2·74	3·00	2·87	2·968
Oct.....	5·98	6·30	3·37	—0·14	—0·002	2·43	2·62	2·525	2·698
Nov...	5·84	5·38	3·15	—0·18	—0·002	2·10	2·50	2·30	2·412
Dec.. .	5·66	5·93	3·11	+0·30	+0·003	1·94	2·20	2·07	2·185
1861									
Jan.....	5·96	5·98	2·83	—0·67	—0·007	1·83	1·99	1·91	1·990
Feb.. .	5·29	4·60	2·55	—0·13	—0·001	1·92	2·03	1·975	1·942
Mar....	5·16	5·72	3·01	+0·96	+0·011	2·31	2·17	2·24	2·108
Apr ...	6·12	6·51	4·00	+0·45	+0·005	2·41	2·37	2·39	2·315
May....	6·57	6·63	4·52	+0·17	+0·002	2·83	2·99	2·91	2·650
June....	6·74	6·84	4·58	+0·06	+0·001	2·99	3·33	3·16	3·035
July....	6·80	6·77	4·34	+0·06	+0·001	3·12	3·45	3·285	3·222
Aug....	6·86	6·95	4·42	—0·02	0·000	3·36	3·56	3·46	3·372
Sept....	6·81	6·73	4·18	—0·23	—0·003	3·05	3·48	3·265	3·362
Oct.....	6·61	6·49	3·94	—0·19	—0·002	2·93	3·26	3·095	3·180
Nov....	6·42	6·34	3·79	—0·11	—0·001	2·70	2·95	2·825	2·960
Dec....	6·31	6·28	3·68	—0·22	—0·002	2·53	2·82	2·675	2·750
1862									
Jan.....	6·09	5·90	3·65	—0·73	—0·008	2·33	2·44	2·385	2·530
Feb....	5·36	4·81	3·36	—0·07	—0·001	2·18	2·43	2·305	2·345
Mar....	5·29	5·77	3·52	+1·09	+0·012	2·48	2·34	2·41	2·358
Apr.....	6·38	6·98	4·37	+0·63	+0·007	2·64	2·55	2·595	2·502
May....	7·01	7·04	4·70	+0·05	+0·001	2·89	2·92	2·905	2·750
June. . .	7·06	7·09	4·69	0·00	0·000	3·02	3·04	3·03	2·968
July....	7·06	7·04	4·67	—0·08	—0·001	2·92	3·09	2·005	3·018
Aug...	6·98	6·93	4·33	—0·17	—0·002	2·91	3·07	2·99	2·998
Sept....	6·81	6·69	3·96	—0·24	—0·003	2·84	2·85	2·845	2·918
Oct.....	6·57	6·45	3·57	—0·28	—0·003	2·73	3·13	2·93	2·888
Nov....	6·29	6·13	3·10	—0·25	—0·003	2·34	2·81	2·575	2·752
Dec....	6·04	5·94	3·25	—0·02	0·000	2·20	2·52	2·36	2·468

a.—St. Clair River discharge use

LAKE MICHIGAN-HURON.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
			2125	0·442			942	0·196		
+0·076	+0·074	+ 356	1447	0·301	1803	0·375	880	0·183	923	0·192
+0·067	+0·077	+ 370	1942	0·404	2312	0·481	874	0·182	1437	0·299
+0·067	+0·073	+ 351	2051	0·427	2402	0·500	932	0·194	1470	0·306
+0·133	+0·136	+ 654	2214	0·461	2868	0·597	1018	0·212	1850	0·385
+0·123	+0·120	+ 577	2326	0·484	2903	0·604	1062	0·221	1841	0·383
−0·036	−0·040	− 192	2002	4·417	1810	0·377	1062	0·221	748	0·156
−0·164	−0·167	− 803	1995	0·415	1192	0·248	1075	0·224	117	0·024
−0·270	−0·269	− 1293	1894	0·394	601	0·125	1057	0·220	− 456	−0·095
−0·286	−0·288	− 1384	2376	0·494	992	0·206	1066	0·222	− 74	−0·015
−0·227	−0·229	− 1101	1935	0·403	834	0·174	1025	0·213	− 191	−0·040
−0·195	−0·192	− 923	2250	0·468	1327	0·276	932	0·194	395	0·082
−0·048	−0·055	− 264	*a*2306	0·480	2042	0·425	875	0·182	1167	0·243
+0·166	+0·165	+ 793	1723	0·358	2516	0·523	813	0·169	1703	0·354
+0·207	+0·218	+ 1048	2166	0·451	3214	0·669	780	0·162	2434	0·506
+0·335	+0·340	+ 1634	2290	0·476	3924	0·816	870	0·181	3054	0·635
+0·385	+0·387	+ 1860	2164	0·450	4024	0·837	1048	0·218	2976	0·619
+0·187	+0·188	+ 904	2274	0·473	3178	0·661	1087	0·226	2091	0·435
+0·150	+0·151	+ 726	2324	0·484	3050	0·635	1133	0·236	1917	0·399
−0·010	−0·010	− 48	2409	0·501	2361	0·491	1126	0·224	1235	0·257
−0·182	−0·185	− 889	2358	0·491	1469	0·306	1092	0·227	377	0·079
−0·220	−0·222	− 1067	2299	0·478	1232	0·256	1098	0·228	134	0·028
−0·210	−0·211	− 1014	2262	0·471	1248	0·260	1018	0·212	230	0·048
−0·220	−0·222	− 1067	2264	0·471	1197	0·249	919	0·191	278	0·058
−0·185	−0·193	− 928	2053	0·427	1125	0·234	826	0·172	299	0·062
+0·013	+0·012	+ 58	1521	0·316	1579	0·328	778	0·162	801	0·167
+0·144	+0·156	+ 750	2024	0·421	2774	0·577	785	0·163	1989	0·414
+0·248	+0·255	+ 1226	2446	0·509	3672	0·764	794	0·165	2878	0·599
+0·218	+0·219	+ 1053	2358	0·491	3411	0·710	983	0·204	2428	0·505
+0·050	+0·050	+ 240	2393	0·498	2633	0·548	986	0·205	1647	0·343
−0·020	−0·021	− 101	2370	0·493	2269	0·472	988	0·206	1281	0·266
−0·080	−0·082	− 394	2428	0·505	2034	0·423	1029	0·214	1005	0·209
−0·030	−0·033	− 159	2411	0·502	2252	0·469	1043	0·217	1209	0·252
−0·136	−0·139	− 668	2393	0·499	1730	0·360	1027	0·214	703	0·146
−0·284	−0.287	− 1380	2362	0·491	982	0·204	949	0·197	33	0·007
−0·166	−0·166	− 798	2212	0·460	1414	0·294	875	0·182	539	0·112

TABLE 25. Continued.

SUPPLY FACTORS

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. Ft. Depth Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1863									
Jan...	576·02	576·09	573·68	+0·06	+0·001	582·13	582·36	582·245	582·302
Feb..	6·08	6·08	3·97	−0·12	−0·001	2·18	2·21	2·195	2·220
Mar.	5·96	5·85	3·93	+0·15	+0·002	2·17	2·16	2·165	2·180
Apr	6·11	6·37	4·00	+0·43	+0·005	2·17	2·23	2·20	2·182
May....	6·54	6·70	4·27	+0·10	+0·001	2·38	2·55	2·465	2·332
June....	6·64	6·58	4·12	−0·05	−0·001	2·47	2·68	2·575	2·520
July....	6·59	6·60	4·01	−0·01	0·000	2·42	2·59	2·505	2·540
Aug..	6·58	6·57	3·97	−0·12	−0·001	2·29	2·60	2·445	2·475
Sept....	6·46	6·36	3·52	−0·37	−0·004	2·11	2·46	2·285	2·365
Oct.....	6·09	5·82	3·07	−0·36	−0·004	2·02	2·20	2·11	2·198
Nov....	5·73	5·64	2·53	−0·14	−0·002	1·58	2·16	1·87	1·990
Dec..	5·59	5·54	2·62	+0·05	+0·001	1·92	1·93	1·925	1·898
1864									
Jan...	5·64	5·75	2·31	−0·18	−0·002	1·69	1·79	1·74	1·832
Feb....	5·46	5·17	2·46	−0·22	−0·002	1·55	1·75	1·65	1·695
Mar....	5·24	5·31	2·69	+0·44	+0·005	1·80	1·75	1·775	1·712
Apr...	5·68	6·04	3·14	+0·59	+0·007	1·51	1·95	1·73	1·752
May....	6·27	6·50	3·93	+0·33	+0·004	2·02	2·38	2·20	1·965
June...	6·60	6·71	3·87	−0·02	0·000	2·01	2·39	2·20	2·200
July....	6·58	6·44	3·62	−0·24	−0·003	1·91	2·34	2·125	2·162
Aug..	6·34	6·25	3·39	−0·20	−0·002	1·73	2·23	1·98	2·052
Sept....	6·14	6·04	3·11	−0·36	−0·004	1·46	1·91	1·685	1·832
Oct.....	5·78	5·51	2·79	−0·32	−0·004	1·07	1·38	1·225	1·455
Nov....	5·46	5·42	2·49	−0·02	0·000	0·90	1·21	1·055	1·140
Dec..	5·44	5·47	2·68	+0·64	+0·007	0·77	1·08	0·925	0·990
1865									
Jan.....	4·80	4·14	2·23	−1·00	−0·011	0·56	0·72	0·64	0·782
Feb....	3·80	3·45	1·65	+0·02	0·000	0·65	0·81	0·73	0·685
Mar....	3·82	4·18	1·99	+0·96	+0·011	0·82	0·98	0·90	0·815
Apr	4·78	5·38	2·66	+0·90	+0·010	1·31	1·47	1·39	1·145
May....	5·68	5·97	3·33	+0·32	+0·004	1·47	1·63	1·55	1·470
June....	6·00	6·02	3·30	+0·10	+0·001	1·51	1·67	1·59	1·570
July....	6·10	6·17	3·27	+0·06	+0·001	1·94	2·10	2·02	1·805
Aug....	6·16	6·16	3·23	−0·04	0·000	1·96	2·12	2·04	2·030
Sept..	6·12	6·07	3·13	−0·18	−0·002	1·84	2·00	1·92	1·980
Oct.....	5·94	5·82	2·82	−0·35	0·004	1·60	1·76	1·68	1·800
Nov....	5·59	5·36	2·31	−0·33	−0·004	1·04	1·20	1·12	1·400
Dec....	5·26	5·16	2·29	−0·16	−0·002	0·73	0·89	0·81	0·965

OF LAKE MICHIGAN-HURON.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan-Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
−0·082	−0·081	− 389	2153	0·448	1764	0·367	820	0·171	944	0·196
−0·040	−0·041	− 197	2040	0·424	1843	0·383	785	0·163	1058	0·220
+0·002	+0·004	+ 19	1878	0·391	1897	0·395	746	0·155	1151	0·239
+0·150	+0·155	+ 745	2122	0·441	2867	0·596	750	0·156	2117	0·440
+0·188	+0·189	+ 909	2307	0·480	3216	0·669	813	0·169	2403	0·500
+0·020	+0·019	+ 91	2204	0·458	2295	0·477	799	0·166	1496	0·311
−0·065	−0·065	− 312	2340	0·487	2028	0·422	840	0·175	1188	0·247
−0·110	−0·111	− 534	2336	0·486	1802	0·375	986	0·205	816	0·170
−0·167	−0·171	− 822	2363	0·492	1541	0·321	976	0·203	565	0·118
−0·208	−0·212	− 1019	2202	0·458	1183	0·246	937	0·195	246	0·051
−0·092	−0·094	− 452	2263	0·471	1811	0·377	854	0·178	957	0·199
−0·066	−0·065	− 312	2187	0·455	1875	0·390	817	0·170	1058	0·220
−0·137	−0·139	− 668	*a*2278	0·474	1610	0·335	739	0·154	871	0·181
+0·017	+0·015	+ 72	2043	0·425	2115	0·440	686	0·143	1429	0·297
+0·040	+0·045	+ 216	2048	0·426	2264	0·471	702	0·146	1562	0·325
+0·213	+0·220	+ 1058	*a*2201	0·458	3259	0·678	702	0·146	2557	0·532
+0·235	+0·239	+ 1149	2309	0·480	3458	0·719	771	0·160	2687	0·559
−0·038	−0·038	− 183	2453	0·510	2270	0·472	810	0·169	1460	0·304
−0·110	−0·113	− 543	2376	0·494	1833	0·381	840	0·175	993	0·207
−0·220	−0·222	− 1067	2341	0·487	1274	0·264	845	0·176	429	0·089
−0·377	−0·381	− 1831	2310	0·481	479	0·100	866	0·180	− 387	−0·081
−0·315	−0·319	− 1533	2121	0·441	588	0·122	806	0·168	− 218	−0·045
−0·150	−0·150	− 721	2162	0·450	1441	0·300	760	0·158	681	0·141
−0·208	−0·201	− 966	2133	0·444	1167	0·243	714	0·149	453	0·094
−0·097	−0·108	− 519	1594	0·332	1075	0·224	661	0·138	414	0·086
+0·130	+0·130	+ 625	1446	0·310	2071	0·431	654	0·136	1417	0·295
+0·330	+0·341	+ 1639	1693	0·352	3332	0·693	624	0·130	2708	0·563
+0·325	+0·335	+ 1610	2092	0·435	3702	0·770	721	0·150	2981	0·620
+0·100	+0·104	+ 500	2204	0·458	2704	0·562	866	0·180	1838	0·382
+0·235	+0·236	+ 1134	2241	0·466	3375	0·702	965	0·201	2410	0·501
+0·225	+0·226	+ 1086	2333	0·485	3419	0·711	1048	0·218	2371	0·493
−0·050	−0·050	− 240	2340	0·487	2100	0·437	1068	0·222	1032	0·215
−0·180	−0·182	− 875	2321	0·483	1446	0·301	1057	0·220	389	0·081
−0·400	−0·404	− 1942	2276	0·473	334	0·069	1009	0·210	− 675	−0·140
−0·435	−0·439	− 2110	2179	0·453	69	0·014	884	0·184	− 815	−0·170
−0·285	−0·287	− 1380	2087	0·434	707	0·147	801	0·167	− 94	−0·020

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. Depth Lake Michigan Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1866									
Jan.....	5·10	5·03	2·00	−0·30	−0·003	0·47	0·63	0·55	0·680
Feb....	4·80	4·58	1·84	−0·18	−0·002	0·23	0·39	0·31	0·430
Mar....	4·62	4·66	2·25	+0·44	+0·055	0·28	0·44	0·36	0·335
Apr....	5·06	5·46	2·78	+0·49	+0·005	0·73	0·88	0·80	0·582
May....	5·55	5·64	3·09	+0·24	+0·003	0·91	1·07	0·99	0·898
June....	5·79	5·94	3·34	+0·26	+0·003	1·20	1·36	1·28	1·135
July....	6·05	6·16	3·46	+0·04	0·000	1·46	1·62	1·54	1·410
Aug....	6·09	6·02	3·25	−0·11	−0·001	1·52	1·68	1·60	1·570
Sept....	5·98	5·93	3·13	—0·07	−0·001	1·37	1·53	1·45	1·525
Oct....	5·91	5·89	3·11	−0·10	−0·001	1·26	1·42	1·34	1·395
Nov....	5·81	5·73	2·74	−0·03	0·000	1·17	1·33	1·25	1·295
Dec....	5·78	5·84	2·87	−0·40	−0·004	0·91	1·07	0·99	1·120
1867									
Jan.....	5·38	4·91	2·56	+0·55	+0·006	0·89	1·05	0·97	0·980
Feb....	5·93	4·95	2·24	−1·19	−0·013	0·94	1·10	1·02	0·995
Mar....	4,74	4,52	2,26	+0·42	+0·005	1·12	1·28	1·20	1·110
Apr....	5·16	5·80	2·93	+0·87	+0·010	1·41	1·57	1·49	1·345
May....	6·03	6·26	3·54	+0·43	+0·005	1·63	1·79	1·71	1·600
June....	6,46	6·65	3·84	0·10	+0·001	1·94	2·10	2·02	1·865
July....	6·56	6·47	3·66	−0·13	−0·001	2·09	2·25	2·17	2·095
Aug....	6·43	6·39	3·39	−0·23	−0·003	2·02	2·18	2·10	2·135
Sept. ..	6·20	6·00	2·94	−0·40	−0·004	1·75	1·91	1·83	1·965
Oct.....	5·80	5·61	2·59	−0·44	−0·005	1·42	1·58	1·50	1·665
Nov....	5·36	5·12	1·96	−0·33	−0·004	0·96	1·04	1·12	1·270
Dec.	5·03	4·94	1·86	−0·12	−0·001	0·61	0·77	0·69	0·865
1868									
Jan.....	4·91	4·88	1·64	−0·56	−0·006	0·45	0·61	0·53	0·610
Feb....	4·35	3·82	1·26	+0·13	+0·001	0·41	0·57	0·59	0·510
Mar....	4·48	51·3	1·87	+0·78	+0·009	1·09	1·25	1·17	0·830
Apr....	5·26	5·38	2·65	+0·38	+0·004	0·99	1·15	1·07	1·120
May....	5·64	5·90	3·19	+0·42	+0·005	1·27	1·43	1·35	1·210
June....	6·06	6·22	3·57	+0·10	+0·001	1·48	1·64	1·56	1·455
July....	6·16	6·11	3·55	−0·22	—0·022	1·51	1·67	1·59	1·575
Aug....	5·94	5·78	3·07	−0·28	−0·003	1·17	1·33	1·25	1·420
Sept....	5·66	5·53	2·74	−0·34	−0·004	0·93	1·09	1·01	1·130
Oct.....	5·32	5·11	2·28	−0·34	−0·004	0·70	0·86	0·78	0·895
Nov....	4·98	4·85	1·99	−0·18	−0·002	0·63	0·79	0·71	0·745
Dec.	4·80	4·76	1·90	−0·21	−0·002	0·35	0·51	0·43	0·570
1869									
Jan.....	4·59	4·42	1·87	−0·35	−0·004	0·25	0·41	0·33	0·380
Feb....	4·24	4·06	1·80	−0·07	−0·001	0·32	0·48	0·40	0·365
Mar....	4,17	4,28	2,30	+0,51	+0·006	0·06	0·22	0·14	0·270
Apr....	4·68	5·09	2·55	+0·49	+0·005	0·43	0·59	0·51	0·325
May....	5·17	5·25	3·19	+0·36	+0·004	0·76	0·92	0·84	0·675
June....	5·53	5·81	3·57	+0·50	+0·006	1·29	1·45	1·37	1·105
July....	6·03	6·25	3·86	+0·23	+0·003	1·67	1·83	1·75	1·560
Aug....	6·26	6·26	3·80	−0·12	−0·001	1·93	2·09	2·01	1·880
Sept....	6·14	6·03	3·47	−0·34	−0·004	1·82	1·98	1·90	1·955
Oct.....	5·80	5·58	3·01	−0·36	−0·004	1·46	1·62	1·54	1,720
Nov....	5·44	5·30	2·42	0·00	0·000	1·34	1·50	1·42	1·480
Dec.	5·44	5·59	2·89	+0·56	+0·006	1·06	1·22	1·14	1·280

a.—St. Clair River discharge used

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
−0·250	−0·253	−1216	*a*2026	0·421	810	0·169	723	0·150	87	0·018
−0·095	−0·097	− 466	1928	0·401	1462	0·304	670	0·139	792	0·165
+0·247	+0·252	+1211	1850	0·385	3061	0·637	670	0·139	2391	0·497
+0·316	+0·321	+1543	*a*1964	0·409	3507	0·729	769	0·160	2738	0·570
+0·237	+0·240	+1154	2098	0·436	3252	0·677	859	0·179	2393	0·498
+0·275	+0·278	+1336	2183	0·454	3519	0·732	907	0·189	2216	0·543
+0·160	+0·160	+ 769	2268	0·472	3037	0·632	983	0·204	2054	0·427
−0·045	−0·046	− 221	2256	0·469	2055	0·423	1038	0·216	997	0·209
−0·130	−0·131	− 630	2243	0·457	1613	0·336	962	0·200	551	0.135
−0·100	−0·101	− 486	2228	0·463	1742	0·362	967	0·201	775	0·161
−0·175	−0·175	− 841	2295	0·477	1454	0·302	889	0·185	565	0·118
−0·140	−0·144	− 692	2272	0·473	1580	0·329	903	0·188	677	0·141
+0·015	+0·021	+ 101	1881	0·391	1982	0·412	829	0·172	1153	0·240
+0·115	+0·102	+ 490	1996	0·415	2486	0·517	799	0·166	1687	0·351
+0·235	+0·240	+1154	1641	0·341	2795	0·581	755	0·157	2040	0·424
+0·255	+0·265	+1274	*a*2118	0·441	3392	0·706	801	0·167	2591	0·539
+0·265	+0·270	+1298	2299	0·478	3597	0·748	834	0·173	2763	0·575
+0·230	+0·231	+1110	2427	0·505	3537	0·736	976	9·203	2561	0·533
+0·040	+0·039	+ 187	2381	0·495	2568	0·534	1062	0·221	1506	0·313
−0·170	−0·173	− 832	2420	0·503	1588	0·330	1036	0·216	552	0·115
−0·300	−0·304	−1461	2337	0·486	876	0·182	1041	0·217	+ 165	−0·034
−0·395	−0·400	−1923	2231	0·464	308	0·064	1036	0·216	− 728	−0·151
−0·405	−0·409	−1966	2154	0·448	188	0·039	935	0·195	− 747	−0·155
−0·255	−0·256	−1231	2093	0·435	862	0·179	850	0·177	12	0·002
−0·100	−0·106	− 501	*a*2042	0·425	1532	0·319	801	0·167	731	0·152
+0·320	+0·321	−1543	1733	0·361	3276	0·682	661	0,138	2615	0,544
+0·290	+0·299	+1437	2179	0·453	3616	0·752	744	0·155	2872	0·597
+0·090	+0·094	+ 452	2095	0·436	2547	0·530	783	0·163	1764	0·367
+0·245	+0·250	+1202	2209	0·460	3411	0·710	907	0·189	2504	0·521
+0·120	+0·121	+ 582	2266	0·471	2848	0·592	891	0·185	1957	0·407
−0·155	−0·157	− 755	2211	0,460	1456	0·303	951	0·198	505	0·105
−0·290	−0·293	−1408	2180	0·454	772	0·161	935	0·195	− 163	−0·034
−0·235	−0·239	−1149	2146	0·446	997	0·207	951	0·198	46	0·010
−0·150	−0·154	− 740	2064	0·429	1324	0·275	944	0·196	380	0·079
−0·175	−0·177	− 851	2016	0·419	1165	0·242	979	0·204	186	0·039
−0·190	−0·192	− 923	1998	0·416	1075	0·224	868	0·181	207	0·043
−0·015	−0·019	− 91	1844	0·384	1753	0·365	806	0·168	947	0·197
−0·095	−0·096	− 461	1692	0·352	1231	0·256	746	0·155	485	0·101
+0·055	+0·061	+ 293	1607	0·334	1900	0·395	642	0·134	1258	0·262
+0·350	+0·355	+1706	1976	0·411	3682	0·766	771	0·160	2911	0·606
+0·430	−0·434	+2086	1848	0·384	3934	0·818	896	0·186	3038	0·632
+0·455	+0·461	+2216	2030	0·422	4246	0·883	903	0·188	3343	0·695
+0·320	+0·323	1553	2184	0,454	3737	0·777	997	0·207	2740	0·570
+0·075	+0·074	+ 356	2211	0·460	2567	0·534	1105	0·230	1462	0·304
−0·235	−0·239	−1149	2192	0·456	1043	0·217	1287	0·268	− 244	−0·051
−0·240	−0·244	−1173	2091	0·435	918	0·191	1168	0·243	− 250	−0·052
−0·200	−0·200	− 961	2121	0·441	1160	0·241	1087	0·226	73	0·015
−0·110	−0·104	− 500	2133	0·444	1633	0·340	926	0·193	707	0·147

Table 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan–Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. Depth Lake Michigan Huron.	Milwaukee, Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1870									
Jan.....	576·00	576·40	573·11	−0·20	−0·002	581·12	581·28	581·20	581·170
Feb ...	5·80	5·19	3·34	−0·60	−0·007	1·21	1·37	1·29	1·245
Mar....	5·20	5·22	3·13	+0·47	+0·005	1·51	1·67	1·59	1·440
Apr....	5·67	6·12	3·73	+0·66	+0·007	1·93	2·09	2·01	1·800
May....	6·33	6·54	4·03	+0·25	+0·003	2·27	2·43	2·35	2·180
June....	6·58	6·61	3·99	+0·13	+0·001	2·41	2·57	2·49	2·420
July....	6·71	6·81	4·04	+0·07	+0·001	2·52	2·68	2·60	2·545
Aug....	6·78	6·76	4·03	−0·16	−0·002	2·43	2·59	2·51	2·555
Sept....	6·62	6·49	3·72	−0·35	−0·004	2·57	2·73	2·65	2·580
Oct.....	6·27	6·05	3·33	−0·34	−0·004	2·17	2·33	2·25	2·450
Nov....	5·93	5·81	2·90	−0·15	−0·002	1·77	1·93	1·85	2·050
Dec. ..	5·78	5·74	2·90	−0·25	−0·003	1·42	1·58	1·50	1·675
1871									
Jan.....	5·53	5·32	2·67	−0·68	−0·008	1·57	1·73	1·65	1·575
Feb....	4·85	4·38	2·34	+0·39	+0·004	1·49	1·65	1·57	1·610
Mar....	5·24	6·10	2·81	+0·92	+0·010	2·09	2·25	2·17	1·870
Apr....	6·16	6·22	3·24	+0·21	+0·002	2·29	2·45	2·37	2·270
May....	6·37	6·52	3·60	+0·19	+0·002	2·64	2·80	2·72	2·545
June....	6·56	6·59	3·62	+0·03	0·000	2·68	2·84	2·76	2·740
July....	6·59	6·59	3·61	−0·09	−0·001	2·71	2·87	2·79	2·775
Aug....	6·50	6·41	3·44	−0·24	−0·003	2·48	2·56	2·52	2·655
Sept....	6·26	6·11	3·21	−0·46	−0·005	1·81	2·24	2·025	2·272
Oct.....	5·80	5·49	2·53	−0·40	−0·044	1·12	1·74	1·43	1·728
Nov....	5·40	5·30	2·22	−0·02	0·000	1·07	1·53	1·30	1·365
Dec. ..	5·38	5·47	1·90	−0·30	−0·003	0·48	1·16	0·82	1·060
1872									
Jan.....	5·08	4·70	1·80	−0·40	−0·004	0·35	0·99	0·67	0·745
Feb....	4·68	4·56	1·56	−0·16	−0·002	0·35	0·79	0·57	0·620
Mar....	4·52	4·40	1·49	+0·10	+0·001	0·13	0·29	0·21	0·390
Apr.....	4·62	4·84	1·64	+0·36	0·004	0·38	0·71	0·545	0·378
May....	4·98	5·12	2·17	+0·36	+0·004	0·63	1·11	0·87	0·708
June....	5·34	5·55	2·53	+0·06	+0·001	1·00	1·51	1·255	1·062
July....	5·40	5·24	2·53	−0·08	−0·001	1·03	1·61	1·32	1·288
Aug....	5·32	5·39	2·54	−0·02	0·000	1·01	1·58	1·295	1·308
Sept....	5·30	5·22	2·25	−0·11	−0·001	0·94	1·48	1·21	1·252
Oct.....	5·19	5·16	2·07	−0·28	−0·003	0·82	1·36	1·09	1·150
Nov....	4·91	4·66	1·61	−0·30	−0·033	0·53	1·06	0·795	0·942
Dec....	4·61	4·56	1·50	−0·31	−0·003	579·87	0·77	0·32	0·558
1873									
Jan.	4·30	4·03	1·38	−0·12	−0·001	9·87	0·60	0·235	0·278
Feb...	4·18	4·32	1·39	+0·32	+0·004	9·91	0·57	0·24	0·238
Mar....	4,50	4,69	1·48	+0·65	+0·007	580·22	0·64	0·43	0·335
April...	5·15	5·61	2·71	+0·50	+0·006	0·79	1·05	0·92	0·675
May....	5·65	5·69	3·47	+0·18	+0·002	1·35	1·55	1·45	1·185
June....	5·83	5·97	3·54	+0·19	+0·002	1·98	1·95	1·965	1·708
July....	6·02	6·07	3·53	+0·05	+0·001	1·94	2·15	2·045	2·005
Aug....	6·07	6·07	3·51	−0·13	−0·001	2·04	2·16	2·10	2·072
Sept....	5·94	5·81	3·05	−0·28	−0·003	1·85	1·99	1·92	2·010
Oct.....	5·66	5·52	2·74	−0·24	−0·003	1·79	1·96	1·875	1·898
Nov....	5·42	5·32	2·41	−0·02	0·000	1·56	1·86	1·71	1·792
Dec....	5·40	5·47	2·90	−0·34	−0·004	1·52	1·70	1·61	1·660

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron. Foot Depth.	Storage in Lake Michigan Huron and Lake St. Clair		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron.	
	Ft. Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Ft. Depth Lake Michigan Huron.	100 c.f.s.	Ft. Depth	100 c.f.s.	Ft. Depth Lake Michigan Huron	100 c.f.s.	Ft. Depth.
+0·075	+0·073	+ 351	*a*2021	0·420	2372	0·493	856	0·178	1516	0·315
+0·195	+0·188	+ 904	1757	0·366	2661	0·554	804	0·167	1857	0·386
+0·360	+0·365	+1755	1853	0·385	3608	0·751	806	0·168	2802	0·583
+0·380	+0·387	+1860	2154	0·448	4014	0·835	824	0·171	3190	0·664
+0·240	+0·243	+1168	2212	0·460	3380	0·703	932	0·194	2448	0·509
+0·125	+0·126	+ 606	2354	0·490	2960	0·616	893	0·186	2067	0·430
+0·010	+0·001	+ 53	2456	0·511	2509	0·522	946	0·197	1563	0·325
+0·025	+0·023	+ 111	2431	0·506	2542	0·529	949	0·197	1593	0·331
−0·130	−0·134	− 644	2373	0·494	1729	0·360	974	0·203	755	0·157
−0·400	−0·404	−1942	2248	0·468	306	0·064	937	0·195	− 631	−0·131
−0·375	−0·377	−1812	2248	0·468	436	0·091	893	0·186	− 457	−0·095
−0·100	−0·103	− 495	2210	0·460	1715	0·357	668	0·139	1047	0·218
+0·035	+0·027	+ 130	2059	0·428	2189	0·455	744	0·155	1445	0·301
+0·260	+0·264	+1269	1679	0·349	2948	0·613	707	0·147	2241	0·466
+0·400	+0·410	+1971	*a*2257	0·470	4228	0·880	644	0·134	3584	0·746
+0·275	+0·277	+1332	2370	0·493	3702	0·770	677	0·141	3025	0·629
+0·195	+0·197	+ 947	2429	0·505	3376	0·702	808	0·168	2568	0·534
+0·035	+0·035	+ 168	2463	0·512	2631	0·547	903	0·188	1728	0·359
−0·120	−0·121	− 582	2466	0·513	1884	0·392	944	0·196	940	0·196
−0·383	−0·386	−1856	2415	0·502	559	0·116	926	0·192	− 367	−0·076
−0·544	−0·549	−2639	2319	0·482	− 320	−0·067	937	0·195	−1257	−0·261
−0·363	−0·367	+1764	2186	0·455	422	0·088	891	0·185	− 469	−0·098
−0·305	−0·305	−1466	2174	0·452	708	0·147	840	0·175	− 132	−0·027
−0·315	−0·318	−1529	2334	0·486	805	0·167	750	0·156	55	0·011
−0·125	−0·129	− 620	1995	0·415	1375	0·286	693	0·144	682	0·142
−0·230	−0·232	−1115	2032	0·423	917	0·191	674	0·140	243	0·051
−0·012	−0·011	− 53	1936	0·403	1883	0·392	619	0·129	1264	0·263
+0·330	+0·334	+1606	*a*1996	0·415	3602	0·749	610	0·127	2992	0·622
+0·354	+0·358	+1721	2100	0·437	3821	0·795	815	0·170	3006	0·625
+0·226	+0·227	+1091	2217	0·461	3308	0·688	854	0·178	2454	0·511
+0·020	+0·019	+ 91	2059	0·428	2150	0·447	946	0·197	1204	0·250
−0·056	−0·056	− 269	2132	0·444	1863	0·388	1020	0·212	843	0·175
−0·102	−0·103	− 495	2126	0·442	1631	0·339	1036	0·216	595	0·124
−0·208	−0·211	−1014	2146	0·446	1132	0·235	1002	0·208	130	0·027
−0·384	−0·387	−1860	2024	0·421	164	0·034	967	0·201	− 803	−0·167
−0·280	−0·283	−1360	2005	0·417	645	0·134	863	0·180	− 218	−0·045
−0·040	−0·041	− 197	1796	0·374	1599	0·333	771	0·160	828	0172
+0·097	+0·101	+ 485	1924	0·400	2410	0·501	732	0·152	167	0·349
+0·340	+0·347	+1668	2069	0·430	3737	0·777	737	0·153	3000	0·624
+0·510	+0·516	+2480	1991	0·414	4471	0·930	741	0·154	3730	0·776
+0·523	+0·525	+2524	2997	0·415	4521	0·940	870	0·181	3651	0·759
+0·297	+0·299	+1437	2133	0·444	3770	0·743	900	0·187	2670	0·555
+0·067	+0·068	+ 327	2195	0·457	2522	0·525	1002	0·208	1520	0·316
−0·062	−0·063	− 303	2201	0·458	1898	0·395	1059	0·220	839	0·175
−0·112	−0·115	− 553	2202	0·458	1649	0·343	1075	0·224	574	0·119
−0·106	−0·109	− 524	2141	0·445	1617	0·336	1048	0·218	569	0·119
−0·132	−0·132	− 635	2134	0·444	1499	0·312	997	0·207	502	0·104
−0·055	−0·059	− 284	2067	0·430	1783	0·371	942	0·196	841	0·175

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. Ft. Dept. Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1874									
Jan.....	5·06	4·66	3·27	−0·69	−0·008	1·48	1·72	1·60	1·605
Feb....	4·37	4·08	3·32	+0·44	+0·005	1·77	1·86	1·815	1·708
Mar....	4·81	5·54	3·37	+0·86	+0·010	1·92	2·00	1·96	1·888
Apr....	5·67	5·80	3·49	+0·14	+0·002	1·82	1·85	1·835	1·898
May....	5·81	5·82	3·67	+0·12	+0·001	1·80	1·90	1·85	1·842
June....	5·93	6·04	3·73	+0·17	+0·002	2·17	2·24	2·205	2·028
July....	6·10	6·17	3·77	+0·03	0·000	2·10	2·40	2·25	2·228
Aug....	6·13	6·09	3·65	−0·16	−0·002	2·11	2·29	2·20	2·225
Sept....	5·97	5·85	3·13	−0·26	−0·003	1·86	2·11	1·985	2·092
Oct.....	5·71	5·57	2·68	−0·29	−0·003	1·51	1·84	1·675	1·830
Nov....	5·42	5·27	2·13	−0·34	−0·004	1·31	1·30	1·305	1·490
Dec....	5·08	4·90	2·04	−0·27	−0·003	0·97	1·45	1·21	1·258
1875									
Jan.....	4·81	4·72	1·79	−0·09	−0·001	0·77	1·16	0·965	1·088
Feb....	4·72	4·71	1·62	+0·08	+0·001	0·70	1·10	0·90	0·932
Mar....	4·80	4·90	1·78	+0·12	+0·001	0·76	1·14	0·95	0·925
Apr....	4·92	4·95	2·13	+0·34	+0·004	1·12	1·33	1·225	1·088
May....	5·26	5·58	2·69	+0·41	+0·005	1·68	1·68	1·68	1·452
June....	5·67	5·76	3·11	+0·19	+0·002	1·92	1·99	1·955	1·818
July....	5·86	5·95	3·25	+0·06	+0·001	1·89	2·18	2·035	1·995
Aug....	5·92	5·89	3·28	−0·12	−0·001	2·06	2·15	2·105	2·070
Sept....	5·80	5·71	3·08	−0·20	−0·002	1·99	2·19	2·09	2·098
Oct....	5·60	5·50	2·58	−0·20	−0·002	1·84	2·00	1·92	2·005
Nov....	5·40	5·31	2·30	−0·17	−0·002	1·63	1·89	1·76	1·840
Dec....	5·23	5·15	2·64	−0·02	0·000	1·44	1·62	1·53	1·645
1876									
Jan.....	5·21	5·27	2·58	−0·31	+0·003	1·39	1·74	1·565	1·548
Feb.. .	5·52	5·78	3·14	+0·66	+0·007	1·59	1·72	1·655	1·610
Mar.. .	6·18	6·59	3·81	+0·42	+0·005	1·92	1·85	1·885	1·770
Apr....	6·60	6·60	4·28	−0·08	−0·001	2·12	2·13	2·125	2·005
May....	6·52	6·43	4·69	+0·36	+0·004	2·74	2·73	2·735	2·430
June....	6·88	7·33	4·79	+0·51	+0·006	3·15	3·22	3·185	2·960
July....	7·39	7·45	4·69	−0·02	0·000	3·49	3·66	3·575	3·380
Aug....	7·37	7·29	4·43	−0·33	−0·004	3·42	3·60	3·51	3·542
Sept....	7·04	6·79	4·20	−0·44	−0·005	3·37	3·49	3·43	3·470
Oct.....	6·60	6·42	3·66	−0·24	−0·003	2·79	3·09	2·94	3·185
Nov....	6·36	6·30	3·61	+0·34	+0·004	2·89	2·94	2·915	2·928
Dec....	6·70	7·09	3·39	+0·14	+0·002	2·42	2·75	2·585	2·750
1877									
Jan.....	576·84	576·50	572·97	−0·95	−0·011	582·28	582·46	582·37	582·478
Feb....	5·89	5·19	2·81	−1·33	−0·015	2·29	2·45	2·37	2·370
Mar....	4·56	3·94	2·60	−0·12	−0·001	2·29	2·38	2·335	2·352
Apr....	4·44	4·94	2·98	+0·66	+0·007	2·67	2·46	2·565	2·450
May....	5·10	5·25	3·32	+0·57	+0·006	2·56	2·63	2·595	2·580
June....	5·67	6·09	3·39	+0·53	+0·006	2·63	2·59	2·61	2·602
July....	6·20	6·30	3·64	+0·06	+0·001	2·60	2·77	2·685	2·684
Aug.. .	6·26	6·22	3·54	−0·18	−0·002	2·48	2·67	2·575	2·630
Sept....	6·08	5·94	3·40	−0·20	−0·002	2·27	2·40	2·335	2·455
Oct.....	5·88	5·83	2·99	0·00	0·000	2·28	2·26	2·27	2·302
Nov....	5·88	5·94	2·78	−0·08	−0·001	2·16	2·21	2·185	2·228
Dec....	5·80	5·67	2·98	−0·20	−0·002	2·10	2·16	2·13	2·158

a.—St. Clair River discharge used.

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
+0·103	+0·095	+ 457	1470	0·306	1927	0·401	815	0·170	1112	0·231
+0·180	+0·185	+ 889	1053	0·219	1942	0·404	778	0·162	1164	0·242
+0·010	+0·020	+ 96	1947	0·405	2043	0·425	753	0·157	1290	0·268
−0·056	−0·054	− 260	2053	0·427	1793	0·373	725	0·151	1068	0·222
+0·186	+0·187	+ 899	1998	0·416	2897	0·603	822	0·171	2075	0·432
+0·200	+0·202	+ 971	2106	0·438	3077	0·640	921	0·192	2156	0·449
−0·003	−0·003	− 14	2168	0·451	2154	0·448	1006	0·209	1148	0·239
−0·133	−0·135	− 649	2164	0·450	1515	0·315	1020	0·212	495	0·103
−0·262	−0·265	−1274	2200	0·458	926	0·193	1016	0·211	− 90	−0·019
−0·340	−0·343	−1649	2185	0·455	536	0·112	1045	0·217	− 509	−0·106
−0·232	−0·236	−1134	2183	0·454	1049	0·218	995	0·207	54	0·011
−0·170	−0·173	− 832	2027	0·422	1195	0·249	972	0·202	223	0·046
−0·156	−0·157	− 755	2008	0·418	1253	0·261	866	0·180	387	0·081
−0·007	−0·006	− 29	2045	0·425	2016	0·419	808	0·168	1208	0·251
+0·163	+0·164	+ 788	2093	0·435	2881	0·599	799	0·166	2082	0·433
+0·364	+0·368	+1769	2027	0·422	3796	0·790	856	0·178	2940	0·612
+0·366	+0·371	+1783	2187	0·455	3970	0·826	928	0·193	3042	0·633
+0·177	+0·179	+ 860	2157	0·449	3017	0·628	997	0·207	2020	0·420
+0·075	+0·076	+ 365	2218	0·461	2583	0·537	1016	0·211	1567	0·326
+0·028	+0·027	+ 130	2175	0·452	2305	0·480	1020	0·212	1285	0·267
−0·093	−0·095	− 457	2140	0·445	1683	0·350	1085	0·226	598	0·124
−0·165	−0·167	− 803	2177	0·453	1374	0·286	1055	0·219	319	0·066
−0·195	−0·197	− 947	2158	0·449	1211	0·252	990	0·206	221	0·046
−0·097	−0·097	− 466	1980	0·412	1514	0·315	861	0·179	653	0·136
+0·062	+0·065	+ 312	2060	0·429	2372	0·493	854	0·178	1518	0·316
+0·160	+0·167	+ 803	2160	0·449	2963	0·616	843	0·175	2120	0·441
+0·235	+0·240	+1154	*a*2188	0·455	3342	0·695	783	0·163	2559	0·532
+0·425	+0·424	+2038	2240	0·466	4278	0·890	792	0·165	3486	0·725
+0·530	+0·534	+2567	1955	0·407	4522	0·941	958	0·199	3564	0·741
+0·420	+0·426	+2048	2511	0·522	4559	0·948	1092	0·227	3467	0·721
+0·162	+0·162	+ 779	2627	0·546	3046	0·709	1200	0·250	2206	0·459
−0·072	−0·076	− 365	2618	0·545	2253	0·469	1211	0·252	1041	0·217
−0·285	−0·290	−1394	2389	0·497	995	0·207	1218	0·253	− 223	−0·046
−0·257	−0·260	−1250	2352	0·489	1102	0·229	1142	0·238	− 40	−0·008
−0·178	−0·174	− 836	2300	0·478	1464	0·305	1078	0·224	386	0·080
−0·272	−0·270	−1298	*a*2283	0·475	985	0·205	965	0·201	20	0·005
−0·108	−0·119	− 572	*a*2371	0·493	1799	0·374	898	0·187	901	0·187
−0·018	−0·033	− 159	1947	0·405	1788	0·372	905	0·188	883	0·184
+0·098	+0·097	+ 466	1342	0·279	1808	0·376	877	0·182	931	0·194
+0·130	+0·137	+ 659	1753	0·365	2412	0·502	850	0·177	1562	0·325
+0·022	+0·028	+ 135	1799	0·374	1934	0·402	850	0·177	1084	0·226
+0·046	+0·052	+ 250	2251	0·468	2501	0·520	900	0·187	1601	0·333
−0·018	−0·017	− 82	2290	0·476	2208	0·459	976	0·203	1232	0·256
−0·175	−0·177	− 851	2277	0·474	1426	0·297	1004	0·209	422	0·088
−0·153	−0·155	− 745	2164	0·450	1419	0·295	949	0·197	470	0·098
−0·074	−0·074	− 356	2232	0·464	1876	0·390	958	0·199	918	0·191
−0·070	−0·071	− 341	1943	0·404	1602	0·333	903	0·188	699	0·145
−0·083	−0·085	− 409	2149	0·447	1740	0·362	866	0·180	874	0·182

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. t. Depte Lake Michigan Huron.	Milwaukee, Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1878									
Jan.....	5·60	5·53	3·04	−0·50	−0·006	1·98	2·06	2·02	2·075
Feb....	5·10	4·67	3·18	−0·33	−0·004	1·91	1·89	1·90	1·960
Mar....	4·76	4·86	3·33	+0·78	+0·009	2·07	2·06	2·065	1·982
Apr....	5·54	6·21	3·70	+0·78	+0·009	2·09	1·99	2·04	2·052
May....	6·32	6·43	3·03	+0·14	+0·002	2·39	2·39	2·39	2·215
June....	6·46	6·49	4·02	+0·07	+0·001	2·53	2·56	2·545	2·465
July....	6·53	6·57	4·03	0·00	0·000	2·54	2·60	2·57	2·558
Aug....	6·53	6·49	3·85	−0·23	−0·003	2·22	2·50	2·36	2·465
Sept....	6·30	6·12	3·66	−0·30	−0·003	2·02	2·21	2·115	2·238
Oct.....	6·00	5·89	3·30	−0·28	−0·003	1·91	2·22	3·065	2·090
Nov....	5·72	5·55	2·97	−0·32	−0·004	1·78	2·03	1·905	1·985
Dec....	5·40	5·25	3·17	−0·37	−0·004	1·46	1·83	1·645	1·775
1879									
Jan.....	5·03	4·81	2·73	−0·53	−0·006	1·15	1·53	1·34	1·492
Feb....	4·50	4·18	2·59	+0·04	0·000	1·16	1·29	1·225	1·282
Mar....	4·54	4·90	2·64	+0·66	+0·007	1·20	1·25	1·225	1·225
Apr..	5·20	5·49	2·95	+0·26	+0·003	1·19	1·28	1·235	1·230
May....	5·46	5·43	3·19	+0·11	+0·001	1·32	1·41	1·365	1·300
June....	5·57	5·71	3·27	+0·17	+0·002	1·39	1·55	1·47	1·418
July....	5·74	5·78	3·31	−0·06	−0·001	1·48	1·59	1·535	1·502
Aug....	5·68	5·58	3·13	−0·21	−0·002	1·29	1·46	1·375	1·455
Sept....	5·47	5·36	2·74	−0·27	−0·003	1·17	1·38	1·275	1·325
Oct.....	5·20	5·03	2·50	−0·32	−0·004	0·95	1·14	1·045	1·160
Nov....	4·88	4·72	1·90	−0·08	−0·001	0·73	1·02	0·875	0·960
Dec....	4·80	4·89	2·28	+0·21	+0·002	0·76	1·00	0·88	0·878
1880									
Jan	5·01	5·13	2·76	−0·07	−0·001	0·80	1·05	0·925	0·902
Feb....	4·94	4·74	2·80	+0·03	0·000	0·71	0·99	0·85	0·888
Mar ...	4·79	5·20	2·96	+0·33	+0·004	0·75	0·98	0·865	0·858
Apr	5·30	5·40	3·07	+0·22	+0·002	0·92	0·99	0·955	0·910
May....	5·52	5·64	3·43	+0·32	+0·004	1·26	1·39	1·325	1·140
June....	5·84	6·04	3·53	+0·16	+0·002	1·77	1·88	1·825	1·575
July....	6·00	5·96	3·63	0·00	0·000	1·99	2·19	2·09	1·958
Aug....	6·00	6·05	3·43	−0·09	−0·001	2·02	2·08	2·05	2·070
Sept....	5·91	5·77	3·14	−0·33	−0·004	1·72	1·97	1·845	1·948
Oct.....	5·58	5·39	2·69	−0·28	−0·003	1·38	1·61	1·495	1·670
Nov....	5·30	5·21	2·48	+0·22	+0·002	1·06	1·49	1·275	1·385
Dec....	5·25	5·82	2·26	−0·50	−0·006	0·89	1·29	1·09	1·182
1881									
Jan.....	5·02	4·21	1·83	−0·56	−0·006	0·90	1·16	1·03	1·060
Feb....	4·46	4·72	1·94	+0·28	+0·003	1·11	1·55	1·33	1·180
Mar....	4·74	4·76	2·28	+0·34	+0·004	1·40	1·56	1·48	1·405
Apr ..	5·08	5·41	2·93	+0·53	+0·006	1·31	1·58	1·445	1·462
May....	5·61	5·81	3·42	+0·35	+0·004	1·82	1·90	1·86	1·652
June....	5·96	6·12	3·65	+0·14	+0·002	2·05	2·07	2·06	1·960
July..	6·10	6·09	3'61	−0·06	−0·001	2·02	2·22	2·12	2·090
Aug.....	6·04	5·98	3·33	−0·14	−0·002	2·02	2·05	2·035	2·078
Sept..	5·90	5·82	2·92	−0·20	−0·002	1·79	1·89	1·84	1·938
Oct.....	5·70	5·58	2·86	−0·06	−0·001	2·12	2·14	2·13	1·985
Nov...	5·64	5·70	2·55	+0·10	+0·001	1·95	2·27	2·11	2·120
Dec..	5·74	5·77	2·8	+0·15	+0·002	1·85	2·10	1·975	2·042

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
−0·115	−0·121	− 582	2054	0·427	1472	0·306	815	0·170	657	0·137
+0·022	+0·018	+ 87	1518	0·316	1605	0·334	755	0·157	850	0·177
+0·070	+0·079	+ 380	1566	0·326	1946	0·405	732	0·152	1214	0·253
+0·163	+0·172	+ 827	2217	0·461	3044	0·633	728	0·151	2316	0·482
+0·253	+0·255	+1226	2231	0·464	3457	0·719	792	0·165	2665	0·554
+0·090	+0·091	+ 437	2271	0·472	2708	0·563	852	0·177	1856	0·386
−0·093	−0·093	− 447	2316	0·482	1869	0·389	877	0·182	992	0·206
−0·227	−0·230	−1106	2330	0·485	1224	0·255	868	0·181	356	0·074
−0·148	−0·151	− 726	2178	0·453	1452	0·302	801	0·167	651	0·135
−0·105	−0·108	− 519	2168	0·451	1649	0·343	826	0·172	823	0·171
−0·210	−0·214	−1029	2088	0·434	1059	0·220	808	0·168	251	0·052
−0·283	−0·287	−1380	1855	0·386	475	0·099	757	0·157	−282	−0·059
−0·210	−0·216	−1038	1771	0·368	733	0·152	665	0·138	68	0·014
−0·057	−0·057	− 274	1482	0·308	1208	0·251	573	0·119	635	0·132
+0·005	+0·012	+ 58	1849	0·385	1907	0·397	518	0·108	1389	0·289
+0·070	+0·073	+ 351	2062	0·429	2413	0·502	548	0·114	1865	0·388
+0·118	+0·119	+ 572	1950	0·406	2522	0·525	633	0·132	1889	0·393
+0·084	+0·086	+ 413	2078	0·432	2591	0·518	665	0·138	1826	0·380
−0·047	−0·048	− 231	2104	0·438	1873	0·390	734	0·153	1139	0·237
−0·130	−0·132	− 635	2052	0·427	1417	0·295	741	0·154	676	0·141
−0·165	−0·168	− 808	2058	0·428	1250	0·270	723	0·150	527	0·110
−0·200	−0·204	− 981	1961	0·408	980	0·204	730	0·152	250	0·052
−0·082	−0·083	− 399	1978	0·411	1579	0·328	688	0·143	891	0·185
+0·024	+0·026	+ 125	1956	0·407	2081	0·433	596	0·124	1485	0·309
+0·014	−0·015	− 72	1931	0·402	1859	0·387	550	0·114	1390	0·272
−0·030	−0·030	− 144	1709	0·356	1565	0·326	543	0·113	1022	0·213
+0·052	+0·056	+ 269	1903	0·396	2172	0·452	522	0·109	1650	0,343
+0·230	+0·232	+ 1115	1974	0·411	3089	0,643	525	0·109	2564	0·533
+0·435	+0·439	+ 2110	1983	0·413	4093	0·851	695	0·145	3398	0·707
+0·383	+0·385	+ 1851	2176	0·453	4027	0·838	870	0·181	3157	0·657
+0·112	+0·112	+ 538	2095	0·436	2683	0·548	926	0·193	1707	0·355
−0·122	−0·123	− 591	2216	0·461	1625	0·338	898	0·187	727	0·151
−0·278	−0·282	− 1356	2153	0·448	797	0·166	935	0·195	− 138	−0·029
−0·285	−0·288	− 1384	2089	0·435	705	0·147	882	0·183	− 177	−0·037
−0·203	−0·201	− 966	2058	0·428	1092	0·227	889	0·185	203	0·042
−0·122	−0·128	− 615	2054	0·427	1439	0·299	824	0·171	615	0·128
+0·120	+0·114	+ 548	1756	0·365	2304	0·479	753	0·157	1551	0·332
+0·225	+0·228	+ 1096	1968	0·409	3064	0·637	730	0·152	2334	0·485
+0·057	+0·061	+ 293	1891	0·393	2184	0·454	734	0·153	1450	0·302
+0·190	+0·196	+ 942	2025	0·421	2967	0·617	709	0·147	2258	0·470
+0·308	+0·312	+ 1500	2083	0·433	3583	0·745	806	0·168	2777	0·577
+0·130	+0·132	+ 635	2182	0·454	2816	0·586	859	0·179	1957	0·407
−0·012	−0·013	− 62	2178	0·453	2116	0·440	905	0·188	1211	0·252
−0·140	−0·142	− 683	2209	0·460	1526	0·317	886	0·184	640	0·133
+0·047	+0·045	+ 216	2247	0·467	2463	0·512	930	0·193	1533	0·319
+0·135	+0·134	+ 644	2137	0·445	2781	0·579	1036	0·216	1745	0·363
+0·078	−0·077	− 370	2288	0·476	1918	0·399	1013	0·211	905	0·188
−0·160	−0·158	− 760	2232	0·464	1472	0·306	937	0·195	535	0·111

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. t. Depte Lake Michigan Huron.	Milwaukee, Wis., Mean of Month.	Harbor Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbor Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1882									
Jan.....	5·89	6·01	3·33	−0·04	0·000	1·63	1·95	1·79	1·882
Feb...	5·85	5·69	3·33	+0·11	+0·001	1·62	1·72	1·67	1·730
Mar...	5·96	6·23	3·80	+0·31	+0·003	1·99	1·86	1·925	1·798
Apr	6·27	6·31	3·97	+0·28	+0·003	2·12	2·08	2·10	2·012
May....	6·55	6·79	4·26	+0·15	+0·002	2·22	2·25	2·235	2·168
June....	6·70	6·62	4·40	+0·20	+0·002	2·49	2·48	2·485	2·360
July....	6·90	7·18	4·34	+0·28	+0·003	2·62	2·62	2·62	2·552
Aug....	7·18	7·18	4·24	−0·34	−0·004	2·81	2·68	2·745	2·682
Sept....	6·84	6·51	3·91	−0·50	−0·006	2·69	2·56	2·625	2·685
Oct.....	6·34	6·16	3·45	−0·32	−0·004	2·28	2·33	2·305	2·465
Nov....	6·02	5·87	3·00	+0·07	+0·001	2·07	2·08	2·075	2·190
Dec....	6·09	6·31	2·61	+0·01	0·000	1·74	1·93	1·835	1·955
1883									
Jan.....	6·10	5·89	2·50	−0·32	−0·004	1·48	1·73	1·605	1·720
Feb....	5·78	5·67	2·71	−0·40	−0·004	1·52	1·68	1·60	1·602
Mar....	5·38	5·09	2·92	+0·01	0·000	1·61	1·72	1·665	1·632
Apr ...	5·39	5·69	2·99	+0·53	+0·006	1·82	1·73	1·775	1·720
May....	5·92	6·14	3·54	+0·59	+0·007	2·30	2·30	2·30	2·038
June....	6·51	6·88	4·23	+0·69	+0·008	2·66	2·72	2·69	2·495
July....	7·20	7·51	4·44	+0·28	+0·003	3·26	3·20	3·23	2·960
Aug....	7·48	7·44	4·42	−0·28	−0·003	3·23	3·40	3·315	3·272
Sept....	7·20	6·95	4·05	−0·46	−0·005	3·04	3·08	3·06	3·188
Oct.....	6·74	6·54	3·72	−0·42	−0·005	2·82	2·75	2·785	2·922
Nov....	6·32	6·09	3·21	−0·28	−0·003	2·37	2·86	2·615	2·700
Dec....	6·04	6·00	3·36	−0·77	−0·009	2·29	2·75	2·52	2·568
1884									
Jan.....	575·27	574·54	573·01	−0·47	−0·005	582·07	582·56	582·315	582·418
Feb....	4·80	5·05	3·27	+0·95	+0·011	2·19	2·41	2·30	2·308
Mar....	5·75	6·45	3·48	+0·84	+0·009	2·44	2·45	2·445	2·373
Apr....	6·59	6·73	3·98	+0·25	+0·003	2·62	2·76	2·69	2·568
May....	6·84	6·96	4·34	+0·21	+0·002	2·83	2·98	2·905	2·798
June....	7·05	7·14	4·41	+0·09	+0·001	2·99	3·04	3·015	2·960
July....	7·14	7·15	4·20	−0·13	−0·001	2·83	3·12	2·975	2·995
Aug....	7·01	6·87	4·08	−0·33	+0·004	2·69	3·00	2·845	2·910
Sept....	6·68	6·48	3·59	−0·33	−0·004	2·44	2·56	2·545	2·695
Oct.....	6·35	6·22	3·25	−0·32	−0·004	2·44	2·81	2·625	2·585
Nov....	6·03	5·84	2·64	−0·13	−0·001	2·08	2·46	2·27	2·448
Dec....	5·90	5·96	2·69	+0·30	+0·003	2·05	2·20	2·125	2·198
1885									
Jan.....	6·20	6·43	2·49	−0·14	−0·002	2·06	2·47	2·265	2·195
Feb....	6·06	5·69	2·28	+0·06	+0·001	2·29	2·38	2·335	2·300
Mar....	6·12	6·56	2·16	+0·47	+0·005	2·25	2·38	2·315	2·325
Apr....	6·59	6·62	2·93	−0·01	0·000	2·44	2·49	2·465	2·390
May....	6·58	6·53	3·75	+0·14	+0·002	2·80	2·89	2·845	2·655
June....	6·72	6·91	4·25	+0·12	+0·001	3·01	3·18	3·095	2·970
July....	6·84	6·78	4·22	0·00	0·000	3·10	3·24	3·17	3·132
Aug....	6·84	6·90	4·27	−0·03	0·000	3·31	3·39	3·35	3·260
Sept....	6·81	6·72	4·06	−0·27	−0·003	3·17	3·29	3·23	2·390
Oct.....	6·54	6·36	3·95	−0·20	−0·002	3·03	3·06	3·045	3·138
Nov....	6·34	6·31	3·70	−0·07	−0·001	2·73	2·87	2·80	2·922
Dec....	6·27	6·23	3·77	−0·47	−0·005	2·44	2·67	2·555	2·678

a.—St. Clair River discharge used.

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
−0·152	−0·152	− 731	2225	0·463	1494	0·311	820	0·171	674	0·140
+0·068	+0·069	+ 332	2045	0·425	2377	0·494	769	0·160	1608	0·335
+0·214	+0·217	+ 1043	2194	0·456	3237	0·673	741	0·154	2496	0·519
+0·156	+0·159	+ 764	2182	0·454	2946	0·613	730	0·152	2216	0·461
+0·192	+0·194	+ 933	2368	0·493	3301	0·687	824	0·171	2477	0·515
+0·192	+0·194	+ 933	2206	0·459	3139	0·653	845	0·176	2294	0·477
+0·130	+0·133	+ 639	2580	0·537	3219	0·670	926	0·193	2293	0·477
+0·003	−0·001	− 5	2615	0·544	2610	0·543	949	0·197	1661	0·346
−0·220	−0·226	− 1086	2321	0·483	1235	0·257	935	0·195	300	0·062
−0·275	−0·279	− 1341	2271	0·472	930	0·193	914	0·190	16	0·003
−0·235	−0·234	− 1125	2251	0·468	1126	0·234	900	0·187	226	0·047
−0·235	−0·235	− 1130	a2139	0·445	1009	0·210	838	0·174	171	0·036
−0·118	−0·122	− 586	a2238	0·466	1652	0·344	739	0·154	913	0·190
+0·030	+0·026	+ 125	2228	0·463	2353	0·489	718	0·149	1635	0·340
+0·088	+0·088	+ 423	1856	0·386	2279	0·474	718	1 561	0325	1·561
+0·318	+0·324	+ 1557	2156	0·449	3713	0·772	734	0·153	2979	0 620
+0·457	+0·464	+ 2230	2230	0·464	4460	0·928	732	0·152	3728	0·776
+0·465	+0·473	+ 2274	2434	0·506	4708	0·979	817	0·170	3891	0·309
+0·312	+0·315	+ 1514	2754	0·573	4268	0·888	859	3,409	0709	0·179
−0·084	−0·087	− 418	2716	0·565	2298	0·478	956	0·199	1342	0·279
−0·266	−0·271	− 1303	2538	0·528	1235	0·257	880	0·183	355	0·074
−0·222	−0·227	− 1091	2402	0·500	1311	0·273	845	0·176	466	0·097
−0·132	−0·135	− 649	2307	0·480	1658	0·345	820	0·171	838	0·174
−0·150	—0·159	− 764	2211	0·460	1447	0·301	760	0·158	687	0·148
−0·110	−0·115	− 553	1514	0·315	961	0·200	737	0·153	224	0·047
+0·064	+0·075	+ 361	1703	0·354	2064	0·429	693	0·144	1371	0·285
+0·196	+0·205	+ 985	2426	0·505	3411	0·710	672	0·140	2739	0·570
+0·230	+0·233	+ 1120	2428	0·505	3548	0·738	633	0·132	2915	0·606
+0·162	+0·164	+ 788	2444	0·508	3232	0·672	718	0·149	2514	0·523
+0·035	+0·036	+ 173	2531	0·527	2704	0·563	741	0·154	1963	0·408
−0·085	−0·086	− 413	211	0·543	2198	0·457	792	0·165	1406	0·292
−0·215	−0·219	− 1053	2489	0·518	1436	0·299	801	0·167	635	0·132
−0·110	−0·114	− 548	2410	0·501	1862	0·387	817	0·170	1045	0·217
−0·137	−0·141	− 678	2367	0·492	1689	0·351	838	0·174	851	0·177
−0·250	−0·251	− 1207	2336	0·486	1129	0·235	861	0·179	268	0·056
−0·003	0·000	0	2384	0·496	2384	0·496	801	0·167	1583	0·329
+0·105	+0·103	+ 495	a2398	0·499	2893	0·602	762	0·159	2131	0·443
+0·025	−0·026	+ 125	2352	0·489	2477	0·515	737	0·153	1740	0·362
+0·065	+0·070	+ 336	a2364	0·492	2700	0·562	704	0·146	1896	0·415
+0·265	+0·265	+ 1274	a2287	0·476	3561	0·741	665	0·138	2896	0·602
+0·315	+0·317	+ 1524	2386	0·496	3910	0·813	799	0·166	3111	0·647
+0·162	+0·163	+ 784	2445	0·509	3229	0·672	877	0·182	2352	0·489
+0·128	+0·128	+ 615	2376	0·494	2991	0·622	919	0·191	2072	0·431
+0·030	+0·030	+ 144	2432	0·506	2576	0·536	969	0·202	1607	0·334
−0·152	−0·155	− 745	2369	0·498	1651	0·343	914	0·190	737	0·153
−0·216	−0·218	− 1048	2217	0·461	1169	0·243	873	0·182	296	0·062
−0·244	−0·245	− 1178	2276	0·473	1098	0·228	856	0·178	242	0·050
−0·066	−0·071	− 341	2204	0·458	1863	0·388	787	0·164	1076	0·224

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. F. Depth Lake Michigan Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1886									
Jan.....	5·80	5·36	3·77	−0·86	−0·010	2·67	2·67	2·67	2·612
Feb....	4·94	4·53	3·04	0·00	0·000	2·69	2·74	2·715	2·692
Mar....	4·94	5·34	2·87	+0·75	+0·008	2·97	2·93	2·95	2·832
Apr....	5·69	6·04	3·70	+0·73	+0·008	3·24	3·22	3·23	3·090
May....	6·42	6·79	4·09	+0·04	+0·004	3·50	3·55	3·525	3·378
June....	6·82	6·85	4·18	+0·02	0·000	3·57	3·64	3·605	3·565
July....	6·84	6·82	4·17	−0·08	−0·001	3·38	3·48	3·43	3·518
Aug....	6·76	6·71	4·01	−0·14	−0·002	3·15	3·33	3·24	3·335
Sept....	6·62	6·53	3·70	−0·19	−0·002	2·91	3·15	3·03	3·135
Oct.....	6·43	6·33	3·46	−0·27	−0·003	2·81	3·02	2·915	2·972
Nov....	6·16	5·98	4·03	−0·08	−0·001	2·47	2·75	2·61	2·762
Dec....	6·08	6·19	3·07	−0·06	−0·001	2·14	2·34	2·285	2·448
1887									
Jan.....	6·02	5·85	2·83	−0·08	−0·001	2·06	2·26	2·16	2·222
Feb....	5·94	6·02	3·26	+0·10	+0·001	2·43	2·45	2·44	2·300
Mar....	6·04	6·05	4·06	+0·13	+0·001	2·59	2·66	2·625	2·532
Apr....	6·17	6·29	4·06	+0·26	+0·003	2·54	2·57	2·555	2·590
May....	6·43	6·57	4·33	+0·19	+0·002	2·74	2·77	2·755	2·655
June....	6·62	6·67	4·34	+0·03	0·000	2·87	2·89	2·88	2·818
July....	6·65	6·63	4·12	−0·11	−0·001	2·81	2·97	2·89	2·885
Aug....	6·54	6·46	3·84	−0·24	−0·003	2·67	2·76	2·715	2·802
Sept....	6·30	6·15	3·55	−0·34	−0·004	2·33	2·41	2·37	2·542
Oct.....	5·96	5·78	2·95	−0·40	−0·004	1·88	2·19	2·035	2·202
Nov....	5·56	5·35	2·55	−0·26	−0·003	1·55	1·74	1·645	1·840
Dec....	5·30	5·25	2·69	−0·04	0·000	1·43	1·45	1·44	1·542
1888									
Jan.....	5·26	5·28	2·49	−0·06	−0·001	1·25	1·34	1·295	1·368
Feb....	5·20	5·12	2·22	−0·21	−0·002	1·20	1·25	1·225	1·260
Mar....	4·99	4·86	2·34	+0·21	+0·002	1·38	1·42	1·40	1·312
Apr....	5·20	5·55	2·92	+0·39	+0·004	1·59	1·56	1·575	1·488
May....	5·59	5·63	3·26	+0·15	+0·002	1·97	2·00	1·985	1·780
June....	5·74	5·85	3·38	+0·24	+0·003	2·24	2·30	2·27	2·128
July....	5·98	6·10	3·54	+0·08	+0·001	2·25	2·33	2·29	2·280
Aug....	6·06	6·01	3·48	−0·18	−0·002	2·13	2·37	2·25	2·270
Sept....	5·88	5·74	2·98	−0·30	−0·003	1·98	2·08	2·03	2·140
Oct.....	5·58	5·42	2·60	−0·23	−0·003	1·73	1·78	1·755	1·892
Nov....	5·35	5·28	2·53	−0·15	−0·002	1·68	1·60	1·64	1·698
Dec....	5·20	5·11	2·53	+0·02	0·000	1·10	1·39	1·245	1·442
1889									
Jan.....	5·22	5·32	2·53	−0·34	−0·004	1·08	1·25	1·165	1·205
Feb....	4·88	4·44	2·37	−0·47	−0·005	1·05	1·17	1·11	1·138
Mar....	4·41	4·38	2·23	+0·14	+0·002	1·03	1·15	1·09	1·100
Apr....	4·55	4·72	2·53	+0·39	+0·004	1·04	1·08	1·06	1·075
May....	4·94	5·16	2·80	+0·50	+0·006	1·12	1·22	1·17	1·115
June....	5·44	5·72	3·22	+0·33	+0·004	1·58	1·55	1·565	1·368
July....	5·77	5·82	3·43	−0·02	0·000	1·76	1·81	1·785	1·675
Aug....	5·75	5·68	3·16	−0·19	−0·002	1·52	1·75	1·635	1·710
Sept....	5·56	5·45	2·71	−0·32	−0·004	1·35	1·58	1·465	1·550
Oct.....	5·24	5·02	2·28	−0·36	−0·004	1·10	1·21	1·155	1·310
Nov....	4·88	4·73	1·88	−0·22	−0·002	0·75	0·87	0·81	0·982
Dec....	4·66	4·60	2·26	+0·16	+0·002	0·57	0·71	0·64	0·725

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
+0·080	+0·070	+ 336	1677	3·049	2013	0·419	707	0·147	1306	0·272
+0·140	+0·140	+ 673	1490	0·310	2163	0·450	670	0·139	1493	0·311
+0·258	+0·266	+ 1279	2008	0·418	3287	0·684	670	0·139	2617	0·544
+0·288	+0·296	+ 1432	2118	0·441	3541	0·737	665	0·138	2876	0·598
+0·187	+0·191	+ 918	2428	0·505	3346	0·696	776	0·161	2570	0·535
−0·047	−0·047	− 226	2432	0·506	2206	0·459	813	0·169	1393	0·290
−0·183	−0·184	− 884	2418	0·503	1534	0·319	852	0·177	682	0·142
−0·200	−0·202	− 971	2406	0·501	1435	0·299	884	0·184	551	0·115
−0·163	−0·165	− 793	2403	0·500	1610	0·335	852	0·177	758	0·158
−0·210	−0·213	− 1024	2364	0·492	1340	0·279	859	0·179	481	0·100
−0·314	−0·315	− 1514	2298	0·478	784	0·163	843	0·175	− 59	−0·012
−0·226	−0·227	− 1091	2403	0·500	1312	0·273	744	0·155	568	0·118
+0·078	+0·077	+ 370	2289	0·476	2659	0·553	693	0·144	1966	0·409
+0·232	+0·233	+1120	2253	0·469	3373	0·702	661	0·138	2712	0·564
+0·058	+0·059	+ 284	1985	0·413	2269	0·472	654	0·136	1615	0·336
+0·065	+0·068	+ 327	2133	0·444	2460	0·512	622	0·129	1838	0·382
+0·163	+0·165	+ 793	2202	0·458	2995	0·623	704	0·146	2291	0·477
+0·067	+0·067	+ 322	2261	0·470	2583	0·537	808	0·168	1775	0·369
−0·083	−0·084	− 404	2319	0·482	1915	0·398	893	0·186	1022	0·213
−0·260	−0·263	−1264	2316	0·482	1052	0·219	866	0·180	186	0·039
−0·340	−0·344	−1654	2233	0·465	579	0·120	834	0·173	− 255	−0·053
−0·362	−0·366	−1759	2217	0·461	458	0·095	875	0·182	− 417	−0·087
−0·298	−0·301	−1447	2109	0·439	662	0·138	822	0·171	− 160	−0·033
−0·174	−0·174	− 836	2016	0·419	1180	0·245	728	0·151	452	0·094
−0·108	−0·109	− 524	2090	0·435	1566	0·326	691	0·144	875	0·182
+0·052	+0·050	+ 240	2086	0·434	2326	0·484	612	0·127	1714	0·357
+0·176	+0·178	+ 856	1922	0·400	2778	0·578	624	0·130	2154	0·448
+0·292	+0·296	−1423	2104	0·438	3527	0·734	622	0·129	2905	0·604
+0·348	+0·350	+1682	2036	0·424	3718	0·773	760	0·158	2958	0·615
+0·152	+0·155	+ 745	2120	0·441	2865	0·596	956	0·199	1909	0·397
−0·010	−0·009	− 43	2208	0·459	2165	0·450	992	0·206	1173	0·244
−0·130	−0·132	− 635	2177	0·453	1542	0·321	990	0·206	552	0·115
−0·248	−0·251	−1207	2186	0·455	979	0·204	972	0·202	7	0·001
−0·194	−0·197	− 947	2131	0·443	1184	0·246	969	0·202	215	0·045
−0·256	−0·258	−1240	2079	0·432	839	0·175	923	0·192	− 84	−0·017
−0·237	−0·237	−1139	1992	0·414	853	0·177	778	0·162	75	0·016
−0·067	−0·071	− 341	2099	0·437	1758	0·366	722	0·150	1036	0·216
−0·038	−0·043	− 207	1701	0·354	1494	0·311	664	0·138	830	0·173
−0·025	−0·023	− 111	1716	0·357	1605	0·334	670	0·139	935	0·195
+0·040	+0·044	+ 212	1792	0·373	2004	0·417	668	0·139	1336	0·278
+0·253	+0·259	+1245	1934	0·402	3179	0·661	780	0·162	2399	0·499
+0·307	+0·311	+1495	2100	0·437	3595	0·748	816	0·170	2779	0·578
+0·035	+0·035	+ 168	2086	0·434	2254	0·469	870	0·181	1384	0·288
−0·160	−0·162	− 779	2097	0·436	1318	0·274	872	0·181	446	0·093
−0·240	−0·244	−1173	2113	0·440	940	0·196	870	0·181	70	0·015
−0·328	−0·332	−1596	2020	0·420	424	0·088	840	0·175	− 416	−0·087
−0·257	−0·259	−1245	1988	0·414	743	0·155	780	0·162	− 37	−0·008
−0·047	−0·045	− 216	1817	0·378	1601	0·333	704	0·146	897	0·187

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan–Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent. F. Depth Lake Michigan Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1890									
Jan.....	4·82	5·05	2·60	+0·18	+0·002	0·65	0·78	0·715	0·678
Feb....	5·00	4·96	2·89	−0·04	0·000	0·61	0·66	0·635	0·675
Mar....	4·96	4·96	3·03	+0·22	+0·002	0·59	0·64	0·615	0·625
Apr....	5·18	5·39	3·47	+0·37	+0·004	0·91	0·78	0·845	0·730
May....	5·55	5·71	3·90	+0·38	+0·004	1·14	1·09	1·115	0·980
June....	5·93	6·15	4·26	+0·17	+0·002	1·55	1·52	1·535	1·325
July....	6·10	6·04	3·89	−0·18	−0·002	1·62	1·71	1·665	1·600
Aug....	5·92	5·81	3·47	−0·24	−0·003	1·54	1·71	1·625	1·6 5
Sept....	5·68	5·54	3·24	−0·27	−0·003	1·34	1·44	1·39	1·508
Oct.....	5·41	5·28	3·04	−0·15	−0·002	1·23	1·23	1·23	1·310
Nov....	5·26	5·24	2·88	−0·12	−0·001	0·89	1·03	0·96	1·095
Dec....	5·14	5·03	2·77	−0·34	−0·004	0·54	0·73	0·635	0·798
1891									
Jan.....	574·80	574·58	572·53	−0·14	−0·002	580·52	580·53	580·525	580·580
Feb....	4·66	4·74	2·51	−0·01	0·000	0·28	0·42	0·35	0·438
Mar....	4·65	4·56	2·99	+0·11	+0·001	0·47	0·39	0·43	0·390
Apr....	4·76	4·97	2·81	+0·22	+0·002	0·78	0·72	0·75	0·590
May....	4·98	4·98	2·72	+0·06	+0·001	0·88	0·96	0·92	0·835
June....	5·04	5·10	2·85	+0·08	+0·001	1·03	0·91	0·97	0·945
July....	5·12	5·13	2·76	−0·04	0·000	0·86	0·94	0·90	0·935
Aug....	5·08	5·03	2·53	−0·13	−0·001	0·79	0·84	0·815	0·858
Sept....	4·95	4·87	2·29	−0·26	−0·003	0·56	0·65	0·605	0·710
Oct.....	4·69	4·51	1·90	−0·31	−0·003	0·20	0·28	0·24	0·422
Nov....	4·38	4·26	1·33	−0·11	−0·001	579·80	579·97	579·885	0·062
Dec....	4·27	4·28	1·52	−0·19	−0·002	9·74	9·91	9·825	579·855
1892									
Jan.....	4·08	3·87	1·53	−0·56	−0·006	9·86	9·93	9·895	9·860
Feb....	3·52	3·18	1·32	−0·23	−0·003	580·05	9·87	9·96	9·928
Mar....	3·29	3·40	1·38	+0·55	+0·006	579·95	9·93	9·94	9·950
Apr....	3·84	4·27	1·89	+0·73	+0·008	580·01	580·05	580·03	9·985
May....	4·57	4·87	2·78	+0·61	+0·007	0·43	0·14	0·285	580·158
June....	5·18	5·50	3·53	+0·40	+0·004	0·88	0·67	0·075	0·530
July....	5·58	5·66	3·66	0·00	0·000	0·89	0·96	0·925	0·850
Aug....	5·58	5·49	3·35	−0·16	−0·002	0·97	1·04	1·005	0·965
Sept....	5·42	5·35	2·97	−0·32	−0·004	0·77	0·87	0·82	0·912
Oct.....	5·10	4·86	2·40	−0·44	−0·005	0·53	0·66	0·595	0·708
Nov....	4·66	4·46	1·94	−0·34	−0·004	0·26	0·33	0·295	0·445
Dec....	4·32	4·18	1·79	−0·58	−0·006	579·99	0·09	0·04	10·168
1893									
Jan.....	3·74	3·31	1·39	−0·35	−0·004	9·98	579·84	579·91	579·975
Feb..—	3·39	3·47	1·47	+0·51	+0·006	580·12	9·79	9·955	9·932
Mar....	3·90	4·34	1·71	+0·68	+0·008	0·23	9·87	580·05	580·002
Apr....	4·58	4·81	2·39	+0·46	+0·005	0·69	580·25	0·47	0·260
May....	5·04	5·28	3·32	+0·42	+0·005	0·99	0·88	0·935	0·702
June....	5·46	5·63	3·50	+0·17	+0·002	1·32	1·21	1·265	1·100
July....	5·63	5·63	3·23	−0·09	−0·001	1·34	1·35	1·345	1·305
Aug....	5·54	5·46	2·93	−0·22	−0·002	1·17	1·21	1·19	1·268
Sept....	5·32	5·17	2·49	−0·30	−0·003	0·85	0·91	0·88	1·035
Oct.....	5·02	4·87	2·13	−0·30	−0·003	0·71	0·73	0·72	0·800
Nov....	4·72	4·58	1·60	−0·12	−0·001	0·32	0·47	0·395	0·558
Dec....	4·60	4·62	1·80	+0·01	0·000	0·25	0·28	0·265	0·330

a.—St. Clair River discharge used.

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan-Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
−0·003	−0·001	− 5	1940	0·404	1935	0·403	714	0·149	1221	0·254
−0·050	−0·050	− 240	1797	0·374	1557	0·324	604	0·126	953	0·198
+0·105	+0·107	+ 514	1745	0·363	2259	0·470	602	0·125	1657	0·345
+0·250	+0·254	+1221	1823	0·379	3044	0·633	588	0·122	2456	0·511
+0·345	+0·349	+1678	1839	0·383	3517	0·732	682	0·142	2835	0·590
+0·275	+0·277	+1332	1964	0·409	3296	0·686	798	0·166	2498	0·520
+0·045	+0·043	+ 207	2046	0·426	2253	0·469	870	0·181	1383	0·288
−0·137	−0·140	− 673	2066	0·430	1393	0·290	852	0·177	541	0·113
−0·198	−0·201	− 966	1994	0·415	1028	0·214	830	0·173	198	0·041
−0·215	−0·217	−1043	1919	0·399	876	0·182	816	0·170	60	0·012
−0·297	−0·298	−1432	1950	0·406	518	0·108	788	0·164	− 270	−0·056
−0·218	−0·222	−1067	1875	0·390	808	0·168	728	0·151	80	0·017
−0·142	−0·144	− 692	1718	0·357	1026	0·213	590	0·123	436	0·091
−0·048	−0·048	− 231	1809	0·376	1579	0·328	612	0·127	966	0·201
+0·200	+0·201	+ 966	1534	0·319	2500	0·520	582	0·121	1918	0·399
+0·245	+0·247	+1187	1830	0·381	3017	0·628	618	0·129	2399	0·499
+0·110	+0·111	+ 534	1865	0·388	2399	0·499	704	0·146	1695	0·353
−0·010	−0·009	− 43	1885	0·392	1842	0·383	694	0·144	1148	0·239
−0·077	−0·077	− 370	1931	0·402	1561	0·325	716	0·149	845	0·176
−0·148	−0·149	− 716	1952	0·406	1236	0·257	718	0·149	518	0·108
−0·288	−0·291	−1399	1943	0·404	544	0·113	704	0·146	− 160	−0·033
−0·360	−0·363	−1745	1878	0·391	133	0·028	716	0·149	− 583	−0·121
−0·207	−0·208	−1000	1912	0·398	912	0·190	694	0·144	218	0·045
+0·005	+0·003	+ 14	1873	0·390	1887	0·393	632	0·131	1255	0·261
+0·068	+0·062	+ 298	1683	0·350	1981	0·412	620	0·129	1361	0·283
+0·022	+0·019	+ 91	1425	0·296	1516	0·315	548	0·114	968	0·201
+0·035	+0·041	+ 197	1508	0·314	1705	0·355	512	0·107	1193	0·248
+0·173	+0·181	+ 870	1767	0·368	2637	0·549	544	0·113	2093	0·435
+0·372	+0·379	+1822	1787	0·372	3609	0·751	646	0·134	2963	0·616
+0·320	+0·324	+1557	1864	0·388	3421	0·712	718	0·149	2703	0·562
+0·115	+0·115	+ 553	1908	0·397	2461	0·512	746	0·155	1715	0·357
−0·053	−0·055	− 264	1926	0·401	1662	0·346	748	0·156	914	0·190
−0·204	−0·208	−1000	1981	0·412	981	0·204	760	0·158	221	0·046
−0·263	−0·268	−1288	1905	0·396	617	0·128	738	0·154	− 121	−0·025
−0·277	−0·281	−1351	1843	0·383	492	0·102	682	0·142	− 190	−0·040
−0·193	−0·199	− 957	1753	0·365	796	0·166	626	0·130	170	0·035
−0·043	−0·047	− 226	1464	0·304	1238	0·258	519	0·108	719	0·150
+0·070	+0·076	+ 365	1514	0·315	1879	0·391	482	0·100	1387	0·291
+0·258	+0·266	+1279	1851	0·385	3130	0·651	484	0·101	2646	0·550
+0·442	+0·447	+2149	1883	0·392	4032	0·839	531	0·110	3501	0·728
+0·398	+0·403	+1937	1817	0·378	3754	0·886	638	0·133	3116	0·648
+0·205	+0·207	+ 995	1950	0·406	2945	0·613	738	0·153	2207	0·459
−0·037	−0·038	− 183	2047	0·426	1864	0·388	775	0·161	1089	0·227
−0·233	−0·235	−1130	2052	0·427	922	0·192	790	0·164	132	0·027
−0·235	−0·248	−1192	2034	0·423	842	0·175	766	0·159	76	0·016
−0·242	−0·245	−1178	1988	0·414	810	0·169	755	0·157	55	0·011
−0·228	−0·229	−1062	1990	0·414	928	0·193	745	0·155	183	0·038
−0·075	−0·075	− 361	1958	0·407	1597	0·332	644	0·134	953	0·198

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date	Water Levels of Detroit River.			Storage in Lake St. Clair		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent Foot Depth. Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1894									
Jan.....	4·61	4·60	2·06	−0·23	−0·003	0·26	0·23	0·245	0·255
Feb....	4·38	4·16	1·94	−0·02	0·000	0·29	0·24	0·265	0·255
Mar....	4·36	4·56	1·99	+0·30	+0·003	0·55	0·39	0·47	0·368
Apr....	4·66	4·75	2·34	+0·34	+0·004	0·70	0·62	0·66	0·565
May....	5·00	5·26	2·82	+0·38	+0·004	1·24	1·02	1·13	0·895
June....	5·38	5·50	3·02	+0·12	+0·001	1·40	1·32	1·36	1·245
July....	5·50	5·50	3·01	−0·10	−0·001	1·43	1·47	1·45	1·405
Aug....	5·40	5·31	2·68	−0·18	−0·002	1·35	1·20	1·275	1·362
Sept....	5·22	5·13	2·45	−0·24	−0·003	0·92	1·01	0·965	1·120
Oct.....	4·98	4·83	2·12	−0·28	−0·003	0·71	0·77	0·74	0·852
Nov....	4·70	4·58	1·75	−0·18	−0·002	0·44	0·58	0·51	0·625
Dec....	4·52	4·46	1·80	+0·16	+0·002	0·09	0·28	0·185	0·348
1895									
Jan.....	4·68	4·89	1·45	+0·24	−0·003	579·91	579·96	579·935	0·060
Feb....	4·92	4·96	1·22	−0·24	−0·003	9·80	9·84	9·82	579·878
Mar....	4·68	4·39	1·25	−0·52	−0·006	9·77	9·85	9·81	9·815
Apr....	4·16	3·93	1·45	−0·05	−0·001	9·97	9·95	9·96	9·885
May....	4·11	4·29	1·76	+0·25	+0·003	580·13	580·12	580·125	580·042
June....	4·36	4·44	1·84	+0·09	+0·001	0·18	0·19	0·185	0·155
July....	4·45	4·46	1·74	−0·01	0·000	0·07	0·16	0·115	0·150
Aug....	4·44	4·43	1·70	−0·08	−0·001	579·95	0·07	0·01	0·062
Sept....	4·36	4·28	1·54	−0·30	−0·003	9·68	579·94	579·81	579·910
Oct.....	4·06	3·84	1·05	−0·37	−0·004	9·31	0·65	9·48	9·645
Nov...	3·69	3·54	0·82	−0·04	0·000	9·09	9·26	9·175	9·328
Dec....	3·65	3·76	1·10	+0·12	+0·001	8·98	9·02	9·00	9·088
1996									
Jan.....	3·77	3·78	1·18	−0·38	−0·004	9·06	9·09	9·075	9·038
Feb....	3·39	3·00	·10	−0·25	−0·003	9·10	9·21	9·155	9·115
Mar....	3·14	3·27	1·07	+0·41	+0·005	9·11	9·11	9·11	9·132
Apr.....	3·55	3·83	1·47	+0·43	+0·005	9·29	9·14	9·215	9·162
May....	3·98	4·41	1·94	+0·34	+0·004	9·57	9·54	9·555	9·385
June....	4·32	4·51	2·20	+0·26	+0·003	9·89	9·91	9·90	9·728
July....	4·58	4·64	2·09	+0·14	+0·002	9·83	9·97	9·90	9·900
Aug....	4·72	4·81	2·34	−0·08	−0·001	9·76	580·01	9·885	9·892
Sept....	4·64	4·46	1·96	−0·25	−0·003	9·66	579·83	9·745	9·815
Oct.....	4·39	4·32	1·71	−0·31	−0·003	9·61	9·63	9·62	9·682
Nov....	4·08	3·85	1·21	−0·27	−0·003	9·39	9·49	9·44	9·530
Dec....	3·81	3·77	1·36	+0·21	+0·002	9·34	9·38	9·36	9·400
1897									
Jan.....	4·02	4·28	1·31	+0·44	+0·005	9·33	9·45	9·39	9·375
Fev....	4·46	4·64	1·51	+0·14	+0·002	9·41	9·36	9·385	9·388
Mar....	4·60	4·57	1·90	+0·06	+0·001	9·72	9·47	9·595	9·490
Apr....	4·66	4·75	2·40	+0·32	+0·004	9·89	9·84	9·865	9·730
May....	4·98	5·20	2·82	+0·18	+0·002	580·38	580·41	580·395	580·130
June....	5·16	5·11	2·91	0·00	0·000	0·65	0·65	0·65	0·522
July....	5·16	5·22	2·91	+0·02	0·000	0·84	0·83	0·835	0·742
Aug....	5·18	5·15	2·79	−0·14	−0·142	0·78	0·84	0·81	0·822
Sept....	5·04	4·93	2·45	−0·28	−0·003	0·53	0·58	0·555	0·682
Oct.....	4·76	4·58	1·95	−0·24	−0·003	0·24	0·23	0·235	0·395
Nov....	4·52	4·47	1·69	−0·14	−0·002	579·98	0·07	0·025	0·130
Dec....	4·38	4·29	1·78	−0·14	−0·002	9·76	579·81	579·785	579·905

a.—St. Clair River discharge used.

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan-Huron.	100 c.f.s.	Foot Depth.
0·000	−0·003	− 14	1876	0·390	1862	0·387	602	0·125	1260	0·262
+0·113	+0·113	+ 543	1698	0·353	2241	0·466	587	0·122	1654	0·344
+0·197	+0·200	+ 961	1877	0·390	2838	0·590	566	0·118	2272	0·473
+0·330	+0·334	+1606	1867	0·388	3473	0·722	638	0·133	2835	0·590
+0·350	+0·354	+1702	1981	0·412	3683	0·766	822	0·171	2861	0·595
+0·160	+0·161	+ 774	2045	0·425	2819	0·586	868	0·181	1951	0·406
−0·043	−0·044	− 212	2048	0·426	1836	0·382	894	0·186	942	0·196
−0·242	−0·244	−1173	2051	0·427	878	0·183	896	0·186	− 18	−0·004
−0·268	−0·271	−1303	2026	0·421	723	0·150	871	0·181	− 148	−0·031
−0·227	−0·230	−1106	1971	0·410	865	0·180	879	0·183	− 14	−0·003
−0·277	−0·279	−1341	1952	0·406	611	0·127	860	0·179	− 249	−0·052
−0·288	−0·286	−1375	1882	0·392	507	0·105	804	0·167	− 297	−0·062
−0·182	−0·179	− 860	*a*1878	0·391	1018	0·212	747	0·155	271	0·056
−0·063	−0·066	− 317	*a*1842	0·383	1525	0·317	721	0·150	804	0·167
+0·070	+0·064	+ 308	1988	0·414	2296	0·478	683	0·142	1613	0·336
+0·157	+0·156	+ 750	1732	0·360	2482	0·516	679	0·141	1803	0·375
+0·113	+0·116	+ 558	1814	0·377	2372	0·493	755	0·157	1617	0·336
−0·005	−0·004	− 19	1861	0·387	1842	0·383	828	0·172	1014	0·211
−0·088	−0·088	− 423	1898	0·395	1475	0·307	873	0·182	602	0·125
−0·152	−0·153	− 735	1895	0·394	1160	0·241	875	0·182	285	0·059
−0·265	−0·268	−1288	1868	0·389	580	0·121	907	0·189	− 327	−0·068
−0·317	−0·321	−1543	1794	0·373	251	0·052	930	0·193	− 679	−0·141
−0·240	−0·240	−1154	1722	0·358	568	0·118	832	0·173	− 264	−0·055
−0·050	−0·049	− 236	1748	0·364	1512	0·315	830	0·173	682	0·142
+0·077	+0·073	+ 351	1736	0·361	2087	0·434	727	0·151	1360	0·283
+0·017	+0·014	+ 67	1410	0·293	1477	0·307	687	0·143	790	0·164
+0·030	+0·035	+ 168	1540	0·320	1708	0·355	649	0·135	1059	0·220
+0·223	+0·228	+1096	1681	0·350	2777	0·578	701	0·146	2076	0·432
+0·343	+0·347	+1668	1688	0·351	3356	0·698	816	0·170	2540	0·528
+0·172	+0·175	+ 841	1791	0·373	2632	0·548	893	0·186	1739	0·362
−0·008	−0·006	− 29	1888	0·393	1859	0·387	918	0·191	941	0·196
−0·077	−0·078	− 375	1898	0·395	1523	0·317	921	0·192	602	0·125
−0·133	−0·136	− 654	1837	0·382	1183	0·246	897	0·187	286	0·059
−0·152	−0·155	− 745	1842	0·383	1097	0·228	816	0·170	281	0·058
−0·130	−0·133	− 639	1840	0·383	1201	0·250	822	0·171	379	0·079
−0·025	−0·023	− 111	1683	0·350	1572	0·327	810	0·169	762	0·159
+0·013	+0·018	+ 86	1925	0·400	2011	0·418	767	0·160	1244	0·259
+0·102	+0·104	+ 500	*a*1784	0·371	2284	0·475	709	0·147	01575	0·328
+0·240	+0·241	+1158	1907	0·397	3065	0·638	712	0·148	2353	0·489
+0·400	+0·404	+1942	1849	0·385	3791	0·789	737	0·153	3054	0·635
+0·392	+0·394	+1894	1950	0·406	3844	0·800	803	0·167	3041	0·633
+0·220	+0·220	+1058	1871	0·389	2929	0·609	871	0·181	2058	0·428
+0·080	+0·080	+ 385	1931	0·402	2316	0·482	912	0·190	1404	0·292
−0·140	−0·142	+ 683	1932	0·402	1249	0·269	942	0·196	307	0·064
−0·287	−0·290	−1394	1926	0·401	532	0·111	910	0·189	− 378	−0·079
−0·265	−0·268	−1288	1898	0·395	610	0·127	871	0·181	− 261	−0·054
−0·225	−0·227	−1091	1916	0·399	825	0·172	850	0·177	− 25	−0·005
−0·167	−0·169	− 812	1807	0·376	995	0·207	758	0·158	237	0·049

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date.	Water Levels of Detroit River.			Storage in Lake St. Clair.		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent, Depth Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1898									
Jan.....	574·24	574·20	571·81	−0·26	−0·003	579·72	579·66	579·69	579·738
Feb....	3·98	3·77	2·01	+0·28	+0·003	9·86	9·72	9·79	9·740
Mar....	4·26	4·76	2·29	+0·62	+0·007	580·18	9·95	580·065	9·928
Apr....	4·88	5·01	2·82	+0·18	+0·002	0·50	580·44	0·47	580·268
May....	5·06	5·11	3·06	+0·12	+0·001	0·78	0·56	0·67	0·570
June....	5·18	5·26	3·08	+0·10	+0·001	0·91	0·72	0·815	0·742
July....	5·28	5·30	2·87	−0·08	−0·001	0·89	0·82	0·855	0·835
Aug....	5·20	5·10	2·71	−0·20	−0·002	0·69	0·71	0·70	0·778
Sept....	5·00	4·90	2·27	−0·23	−0·003	0·34	0·52	0·43	0·565
Oct.....	4·77	4·64	2·06	−0·13	−0·001	0·33	0·21	0·275	0·350
Nov....	4·64	4·65	1·81	+0·02	0·000	579·92	0·13	0·02	0·148
Dec....	4·66	4·68	1·76	0·00	0·000	9·58	579·94	579·76	579·892
1899									
Jan.....	4·66	4·65	1·89	−0·05	−0·001	9·53	9·68	9·605	9·682
Feb....	4·61	4·57	1·68	−0·53	−0·006	9·61	9·54	9·575	9·590
Mar....	4·08	3·59	2·07	−0·12	−0·001	9·81	9·69	9·75	9·662
Apr....	3·96	4·32	2·32	+0·64	+0·007	580·08	9·86	9·97	9·860
May....	4·60	4·88	2·72	+0·43	+0·005	0·52	580·40	580·46	580·215
June....	5·03	5·18	2·83	+0·21	+0·002	0·83	0·79	0·81	0·635
July....	5·24	5·30	2·76	+0·02	0·000	1·04	1·08	0·16	0·935
Aug....	5·26	5·22	2·59	−0·18	−0·002	0·96	0·99	0·975	1·018
Sept....	5·08	4·93	2·14	+0·71	+0·008	0·82	0·79	0·805	0·890
Oct....	5·79	4·65	1·98	−1·22	0·014	0·49	0·38	0·435	0·620
Nov....	4·57	4·49	1·85	−0·27	−0·003	0·31	0·24	0·275	0·355
Dec....	4·30	4·10	1·40	−0·24	−0·003	579·81	0·05	579·93	0·102
1900									
Jan.....	4·06	4·03	1·60	+0·08	+0·001	9·66	579·82	9·74	579·835
Feb....	4·14	4·24	1·80	+0·32	+0·004	9·77	9·83	9·80	9·770
Mar....	4·46	4·67	2·19	+0·20	+0·002	9·94	9·86	9·90	9·850
Apr....	4·66	4·64	2·44	+0·06	−0·001	580·07	9·98	580·025	9·962
May....	4·72	4·79	2·63	+0·17	+0·002	0·31	580·13	0·22	58·122
June....	4·89	4·99	2·73	+0·11	+0·001	0·42	0·30	0·36	0·290
July....	5·00	5·01	2·56	+0·04	+0·000	0·53	0·55	0·54	0·450
Aug....	5·04	5·06	2·56	−0·06	−0·001	0·70	0·64	0·67	0·605
Sept....	4·98	4·89	2·20	−0·16	−0·002	0·65	0·72	0·685	0·678
Oct.....	4·82	4·74	2·03	−0·19	−0·002	0·66	0·66	0·66	0·672
Nov....	4·63	4·52	1·55	−0·17	−0·002	0·52	0·66	0·59	0·625
Dec....	4·46	4·41	1·60	−0·25	−0·003	0·19	0·46	0·325	0·458
1901									
Jan.....	4·21	4·01	1·63	−0·67	−0·007	579·95	0·22	0·085	0·205
Feb....	3·54	3·06	1·19	−0·35	−0·004	9·92	0·08	0·00	0·042
Mar....	3·19	3·32	1·12	−0·19	−0·002	580·34	0·07	0·205	0·102
Apr....	3·00	2·69	1·39	+0·32	+0·004	0·49	0·55	0·52	0·362
May....	3·32	3·94	1·56	+1·06	+0·012	0·92	0·81	0·865	0·692
June....	4·38	4·81	2·03	+0·54	+0·006	0·97	0·91	0·94	0·902
July....	4·92	5·04	2·20	+0·14	+0·002	1·06	1·06	1·06	1·000
Aug....	5·06	5·07	2·14	−0·08	−0·001	1·11	1·11	1·11	1·085
Sept....	4·98	4·89	2·03	−0·26	−0·003	0·92	0·88	0·90	1·005
Oct.....	4·72	4·56	1·59	−0·29	0·003	0·56	0·66	0·61	0·755
Nov....	4·43	4·30	1·19	−0·05	−0·001	0·23	0·43	0·33	0·470
Dec....	4·38	4·47	1·62	−0·49	−0·005	579·95	0·10	0·025	0·178

a.—St. Clair River discharge used.

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth.	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Outflow through Chicago Drainage Canal.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron.	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth.
+0·002	−0·001	− 5	1756	0·365			1751	0·364	670	0·139	1081	0·225
+0·188	+0·191	+ 918	1482	0·308			2400	0·499	627	0·130	1773	0·369
+0·340	+0·347	+1668	1888	0·393			3556	0·740	599	0·125	2957	0·615
+0·302	+0·304	+1461	1848	0·384			3309	0·688	623	0·130	2686	0·559
+0·172	+0·173	+ 832	1818	0·378			2650	0·551	678	0·141	1972	0·410
+0·093	+0·094	+ 452	1893	0·394			2345	0·488	755	0·157	1590	0·331
−0·057	−0·058	− 279	1986	0·413			1707	0·355	819	0·170	888	0·185
−0·213	−0·215	−1034	1931	0·402			897	9·187	841	0·175	56	0,012
−0·215	−0·218	−1048	1964	0·409			916	0·191	866	0·180	50	0·010
−0·202	−0·203	− 976	1896	0·394			920	0·191	836	0·174	84	0·017
−0·256	−0·256	−1231	1969	0·410			738	0·154	804	0·167	− 66	0·014
−0·210	−0·210	−1009	1996	0,415			987	0,205	789	0·164	198	0·041
−0·092	−0·093	− 447	1947	0·405			1500	0·312	699	0·145	801	0·167
+0·072	+0·066	+ 317	*a*1856	0·386			2173	0·452	668	0·139	1505	0·313
+0·198	+0·197	+ 947	1366	0·284			2313	0·481	648	0·135	1665	0·346
+0·355	+0·362	+1740	1655	0·344			3395	0·706	657	0·137	2738	0·570
+0·420	+0·425	+2043	1812	0·377			3855	0,802	819	0·170	3036	0·632
+0·300	+0·302	+1452	1935	0·403			3387	0·705	902	0·188	2485	0·715
+0·083	+0·083	+ 399	2022	0·421			2421	0·504	940	0·196	1481	0·308
−0·128	−0·130	− 625	2031	0·423			1406	0·292	968	0·201	438	0·091
−0·270	−0·262	−1259	2015	0·419			756	0·157	1004	0·209	− 248	−0·052
−0·265	−0·279	−1341	1923	0·400			582	0·121	942	0·196	− 360	−0·075
−0·253	−0·256	−1231	1883	0·392			652	0·136	926	0·193	− 274	−0·057
−0·267	−0·270	−1298	1882	0,379			524	0·109	917	0·191	393	−0·082
−0·065	−0·064	− 308	1736	0·361	15	0·003	1443	0·300	793	0·165	650	0·135
+0·080	+0·084	+ 404	1778	0·370	23	0,005	2205	0·459	770	0·160	1435	0·299
+0·112	+0·114	+ 548	1874	0·390	21	0·004	2443	0·508	723	0·150	1720	0·358
+0·160	+0·161	+ 774	1780	0·370	27	0·006	2581	0·537	730	0·152	1851	0·385
+0·168	+0·170	+ 817	1796	0·374	32	0·007	2645	0·550	764	0·159	1881	0·391
+0·160	+0·161	+ 774	1868	0·389	32	0·007	2674	0·556	777	0·162	1897	0·395
+0·155	+0·155	+ 745	1932	0·402	34	0·007	2711	0·564	818	0·170	1893	0·394
+0·073	+0·072	+ 346	1957	0·407	36	0·007	2339	0·487	857	0·178	1482	0·308
−0·006	−0·008	− 38	1978	0·411	23	0·005	1963	0·408	948	0·197	1015	0·211
−0·047	−0·049	− 236	1953	0·406	34	0·007	1751	0·364	954	0·198	797	0·166
−0·167	−0·169	− 812	1974	0·411	38	0·008	1200	0·260	974	0·203	226	0·047
−0·253	−0·256	−1231	1911	0·398	42	0·009	722	0·150	900	0·187	− 178	−0·037
−0·163	−0·170	− 817	1719	0·358	49	0·010	951	0·198	818	0·170	133	0·028
+0·060	+0·056	+ 269	1410	0·293	51	0·011	1730	0·360	764	0·159	966	0·201
+0·260	+0·258	+1240	1548	0·322	53	0·011	2841	0·591	725	0·151	2116	0·440
+0·330	+0·334	+1606	1161	0·241	44	0·009	2811	0·585	745	0·155	2066	0·430
+0·210	+0·222	+1067	1706	0·355	31	0·006	2804	0·583	798	0·166	2006	0·417
+0·098	+0·104	+ 500	1986	0·413	29	0·006	2515	0·523	814	0·169	1701	0·354
+0·085	+0·087	+ 418	2052	0·427	31	0·006	2501	0·520	888	0·185	1613	0·336
−0·080	−0·081	− 389	2084	0·434	39	0·008	1734	0·361	920	0·191	814	0·169
−0·250	−0·253	−1216	2025	0·421	39	0·008	848	0·176	895	0·186	− 47	−0·010
−0·285	−0·288	−1384	1983	0·413	38	0·008	637	0·133	798	0·166	− 161	−0·033
−0·292	−0·293	−1408	1963	0·408	39	0·008	594	0·124	788	0·164	− 194	−0·040
−0·226	−0·231	−1110	1935	0·403	41	0·009	866	0·180	728	0·151	138	0·029

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date.	Water Levels of Detroit River.			Storage in Lake St. Clair.		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent Depth Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1902									
Jan.....	3·89	3·31	1·20	−0·75	−0·008	9·76	580·00	579·88	579·952
Feb....	3·14	2·96	0·86	+0·32	+0·004	9·61	579·81	9·71	9·795
Mar....	3·46	3·96	1·13	+0·63	+0·007	9·84	9·73	9·785	9·748
Apr.....	4·09	4·22	1·63	+0·27	+0·003	9·91	9·91	9·91	9·848
May....	4·36	4·50	2·09	+0·33	+0·004	580·30	580·16	580·23	580·070
June....	4·69	4·88	2·33	+0·50	+0·006	0·50	0·48	0·49	0·360
July....	5·19	5·50	2·99	+0·27	+0·003	0·83	0·76	0·795	0·642
Aug....	5·46	5·41	3·00	−0·22	−0·002	0·85	0·83	0·84	0·818
Sept....	5·24	5·08	2·64	−0·24	−0·003	0·48	0·51	0·495	0·668
Oct.....	5·00	4·92	2·50	−0·23	−0·003	0·33	0·27	0·30	0·398
Nov....	4·77	4·62	2·20	−0·14	−0·002	0·20	0·17	0·185	0·242
Dec....	4·63	4·64	1·98	+0·03	0·000	579·91	579·93	579·92	0·052
1903									
Jan.....	4·66	4·69	1·81	−0·12	−0·001	9·69	9·74	9·715	579·818
Feb....	4·54	4·40	1·81	+0·04	0·000	9·85	9·78	9·815	9·765
Mar....	4·58	4·75	2·44	+0·45	+0·005	580·06	9·92	9·99	9·902
Apr....	5·03	5·31	3·20	+0·26	+0·003	0·33	580·27	580·30	580·145
May....	5·29	5·27	3·34	+0·03	0·000	0·43	0·39	0·41	0·355
June....	5·32	5·38	3·22	+0·09	+0·001	0·61	0·56	0·585	0·498
July....	5·41	5·44	3·18	−0·01	0·000	0·79	0·75	0·77	0·678
Aug....	5·40	5·36	2·99	−0·08	−0·001	0·72	0·73	0·725	0·748
Sept....	5·32	5·29	2·82	−0·16	−0·002	0·77	0·80	0·785	0·755
Oct.....	5·16	5·04	2·39	−0·37	−0·004	0·50	0·83	0·665	0·725
Nov....	4·79	4·54	1·84	−0·05	−0·001	0·14	0·41	0·275	0·470
Dec....	4·74	4·94	1·67	−0·40	−0·004	579·88	0·12	0·00	0·138
1904									
Jan....	4·34	3·74	1·56	−0·51	−0·006	9·90	579·91	579·905	579·952
Feb...	3·83	3·92	1·61	+0·59	+0·007	9·86	9·91	9·885	9·895
Mar....	4·42	4·92	2·20	+0·86	+0·010	580·14	580·08	580·11	9·998
Apr....	5·28	5·64	3·28	+0·34	+0·004	0·60	0·63	0·615	580·362
May....	5·62	5·61	3·60	+0·14	+0·002	0·95	0·96	0·955	0·785
June....	5·76	5·92	3·74	+0·18	+0·002	1·35	1·42	1·385	1·170
July....	5·94	5·97	3·68	−0·04	0·000	1·36	1·55	1·455	1·420
Aug....	5·90	5·82	3·38	−0·19	−0·002	1·26	1·53	1·395	1·425
Sept....	5·71	5·60	3·08	−0·25	−0·003	1·19	1·36	1·275	1·335
Oct.....	5·46	5·31	2·73	−0·34	−0·004	1·06	1·26	1·16	1·218
Nov....	5·12	4·94	2·24	−0·20	−0·002	0·75	0·95	0·85	1·005
Dec....	4·92	4·89	2·05	−0·58	−0·006	0·44	0·50	0·47	0·660
1905									
Jan.....	574·34	573·78	571·73	−0·70	−0·008	580·27	580·38	580·325	580·398
Feb....	3·64	3·50	1·45	+0·04	0·000	0·21	0·30	0·255	0·290
Mar....	3·68	3·87	1·55	+0·62	+0·007	0·33	0·29	0·31	0·282
Apr....	4·30	4·73	2·03	+0·62	+0·007	0·71	0·66	0·685	0·498
May....	4·92	5·11	2·76	+0·46	+0·005	0·97	0·95	0·96	0·822
June....	5·38	5·66	3·22	+0·35	+0·004	1·36	1·40	1·38	1·170
July....	5·73	5·80	3·30	+0·04	0·000	1·54	1·57	1·555	1·468
Aug....	5·77	5·74	3·18	−0·14	−0·002	1·51	1·56	1·535	1·545
Sept....	5·63	5·52	2·90	−0·28	−0·003	1·41	1·45	1·43	1·482
Oct.....	5·35	5·18	2·45	−0·34	−0·004	0·97	1·22	1·095	1·262
Nov....	5·01	4·84	2·02	−0·23	−0·003	0·71	0·93	0·82	0·958
Dec....	4·78	4·73	2·05	+0·02	0·000	0·55	0·67	0·61	0·715

a.—St. Clair River discharge used.

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth.	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Outflow through Chicago Drainage Canal.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron.	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth.
−0·157	−0·165	− 793	1522	0·317	42	0·009	771	0·160	670	0·139	101	0·021
−0·047	−0·043	− 207	1464	0·305	42	0·009	1299	0·271	625	0·130	674	0·140
+0·100	+0·107	+ 514	1827	0·380	42	0·009	2383	0·496	613	0·128	1770	0·368
+0·222	+0·225	+1082	1816	0·378	42	0·009	2940	0·612	638	0·133	2302	0·479
+0·290	+0·294	+1413	1818	0·378	42	0·009	3273	0·681	667	0·139	2606	0·542
+0·282	+0·288	+1384	1936	0·403	41	0·009	3361	0·699	725	0·151	2636	0·548
+0·176	+0·179	+ 860	2054	0·427	43	0·009	2957	0·615	760	0·158	2197	0·457
−0·150	−0·152	− 731	2003	0·417	42	0·009	1314	0·273	762	0·159	552	0·115
−0·270	−0·273	−1312	1944	0·404	43	0·009	675	0·140	770	0·160	− 95	−0·020
−0·156	−0·159	− 764	1905	0·396	42	0·009	1183	0·246	746	0·155	437	0·091
−0·190	−0·192	− 923	1846	0·384	42	0·009	965	0·201	757	0·157	208	0·043
−0·234	−0·234	−1125	1919	0·399	54	0·011	848	0·176	731	0·152	117	0·024
−0·053	−0·054	− 260	1988	0·414	61	0·013	1789	0·368	660	0·137	1129	0·235
+0·137	+0·137	+ 659	1851	0·385	57	0·012	2567	0·534	624	0·130	1943	0·404
+0·243	+0·248	+1192	1837	0·382	53	0·011	3082	0·641	610	0·127	2472	0·514
+0·210	+0·213	+1024	1879	0·391	46	0·010	2949	0·613	649	0·135	2300	0·478
+0·143	+0·143	+ 687	1803	0·375	46	0·010	2536	0·528	709	0·147	1827	0·380
+0·180	+0·181	+ 870	1911	0·398	48	0·010	2829	0·589	774	0·161	2055	0·428
+0·070	+0·070	+ 336	1958	0·407	49	0·010	2343	0·487	795	0·165	1548	0·322
+0·007	+0·006	+ 29	1978	0·411	45	0·009	2052	0·427	810	0·169	1242	0·258
−0·030	−0·032	− 154	1997	0·415	43	0·009	1886	0·392	813	0·169	1073	0·223
−0·255	−0·259	−1245	1999	0·416	45	0·009	799	0·166	838	0·174	− 39	−0·008
−0·332	−0·333	−1601	1910	0·397	47	0·010	356	0·074	818	0·170	− 462	−0·096
−0·186	−0·190	− 913	2138	0·445	56	0·012	1281	0·266	750	0·156	531	0·110
−0·057	−0·063	− 303	1612	0·335	55	0·011	1364	0·284	666	0·139	698	0·145
+0·103	+0·096	+ 461	1682	0·350	52	0·011	2195	0·457	630	0·131	1565	0·326
+0·364	+0·374	+1798	*a*1825	0·380	55	0·011	3678	0·765	593	0·123	3085	0·642
+0·423	+0·427	+2053	2035	0·423	49	0·010	4137	0·861	649	0·135	3488	0·726
+0·385	+0·387	+1860	1902	0·396	51	0·011	3813	0·793	700	0·146	3113	0·648
+0·250	+0·252	+1211	2031	0·423	41	0·009	3283	0·683	739	0·154	2544	0·529
+0·005	+0·005	+ 24	2083	0·433	45	0·009	2152	0·448	760	0·158	1392	0·290
−0·090	−0·092	− 442	2103	0·437	42	0·009	1703	0·354	771	0·160	932	0·194
−0·117	−0·120	− 577	2079	0·432	42	0·009	1544	0·321	787	0·164	757	0·157
−0·213	−0·217	−1043	2035	0·423	42	0·009	1034	0·215	813	0·169	221	0·046
−0·345	−0·347	−1668	1992	0·414	42	0·009	366	0·076	796	0·166	− 430	−0·089
−0·262	−0·268	−1288	2019	0·420	42	0·009	773	0·161	732	0·152	41	0·009
−0·108	−0·116	− 558	1580	0·329	42	0·009	1064	0·221	788	0·164	276	0·057
−0·008	−0·008	− 38	1534	0·319	42	0·009	1538	0·320	712	0·148	826	0·172
+0·216	+0·223	+1072	1676	0·349	42	0·009	2790	0·580	670	0·139	2120	0·441
+0·324	+0·331	+1591	1947	0·405	42	0·009	3580	0·745	747	0·155	2833	0·589
+0·348	+0·353	+1697	1922	0·400	42	0·009	3661	0·762	801	0·166	2860	0·595
+0·298	+0·302	+1452	2066	0·430	42	0·009	3560	0·741	834	0·173	2726	0·567
+0·077	+0·077	+ 370	2118	0·441	42	0·009	2530	0·526	899	0·187	1631	0·339
−0·063	−0·065	− 312	2124	0·442	42	0·009	1854	0·386	923	0·192	931	0·194
−0·220	−0·223	−1072	2094	0·436	42	0·009	1064	0·221	958	0·199	106	0·221
−0·304	−0·308	−1481	2052	0·427	42	0·009	613	0·128	965	0·201	− 352	−0·073
−0·243	−0·246	−1182	2004	0·417	42	0·009	864	0·180	923	0·192	− 59	−0·012
−0·145	−0·145	− 697	1942	0·404	42	0·009	1287	0·268	884	0·184	403	0·084

TABLE 25—Continued.

SUPPLY FACTORS OF LAKE

Date.	Water Levels of Detroit River.			Storage in Lake St. Clair.		Water Levels of Lake Michigan-Huron.			
	Windmill Point.		Amherstburg, Ont., Mean of Month.	Foot Depth.	Equivalent, Depth Lake Michigan-Huron.	Milwaukee, Wis., Mean of Month.	Harbour Beach, Mich., Mean of Month.	Mean, Milwaukee and Harbour Beach.	
	First of Month.	Mean of Month.						Mean of Month.	First of Month.
1906									
Jan.....	4·80	4·86	2·10	−0·38	−0·004	0·53	0·53	0·53	0·570
Feb....	4·42	3·99	2·14	−0·42	−0·005	0·68	0·69	0·685	0·608
Mar....	4·00	4·00	2·00	+0·44	+0·005	0·83	0·76	0·795	0·740
Apr....	4·44	4·88	2·43	+0·60	+0·007	1·01	0·94	0·975	0·885
May....	5·04	5·20	2·68	+0·27	+0·003	1·27	1·20	1·235	1·105
June....	5·31	5·42	2·92	+0·19	+0·002	1·39	1·33	1·36	1·298
July....	5·50	5·58	3·02	+0·06	+0·001	1·44	1·45	1·445	1·402
Aug....	5·56	5·54	2·97	−0·14	−0·002	1·41	1·36	1·385	1·415
Sept....	5·42	5·30	2·70	−0·23	−0·003	1·06	1·12	1·09	1·238
Oct.....	5·19	5·08	2·38	−0·15	−0·002	0·86	0·87	0·865	0·978
Nov....	5·04	4·99	2·32	−0·10	−0·001	0·68	0·68	0·68	0·772
Dec....	4·94	4·89	2·48	−0·02	0·000	0·69	0·65	0·67	0·675
1907									
Jan.....	4·92	4·94	2·91	−0·12	−0·001	0·60	0·65	0·625	0·648
Feb....	4·80	4·65	2·66	−0·18	−0·002	0·64	0·68	0·66	0·642
Mar....	4·62	4·60	2·47	+0·30	+0·003	0·70	0·68	0·69	0·675
Apr....	4·92	5·24	2·94	+0·42	+0·005	0·96	0·90	0·93	0·810
May....	5·34	5·44	3·17	+0·27	+0·003	1·12	1·08	1·10	1·015
June....	5·61	5·78	3·63	+0·23	+0·003	1·48	1·39	1·435	1·268
July....	5·84	5·90	3·59	−0·01	0·000	1·48	1·64	1·56	1·498
Aug....	5·83	5·76	3·35	−0·19	−0·002	1·38	1·49	1·435	1·498
Sept....	5·64	5·51	3·03	−0·18	−0·002	1·37	1·42	1·395	1·415
Oct.....	5·46	5·40	2·94	−0·24	−0·003	1·16	1·21	1·185	1·290
Nov....	5·22	5·05	2·53	−0·22	−0·002	0·74	0·83	0·785	0·985
Dec....	5·00	4·96	2·41			0·63	0·62	0·625	0·705

MICHIGAN-HURON—Continued.

Storage in Lake Michigan-Huron, Foot Depth.	Storage in Lake Michigan-Huron and Lake St. Clair.		Outflow through Detroit River.		Outflow through Chicago Drainage Canal.		Total Supply to Lake Michigan-Huron.		Inflow from St. Marys River.		Local Supply to Lake Michigan-Huron.	
	Foot Depth Lake Michigan Huron.	100 c.f.s.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s	Foot Depth.	100 c.f.s.	Foot Depth Lake Michigan Huron.	100 c.f.s.	Foot Depth.
+0·038	+0·034	+ 163	1991	0·414	42	0·009	2196	0·457	821	0·171	1375	0·286
+0·132	+0·127	+ 610	1548	0·322	42	0·009	2200	0·458	760	0·158	1440	0·300
+0·145	+0·150	+ 721	1600	0·333	42	0·009	2363	0·492	720	0·150	1643	0·342
+0·220	+0·227	+1091	1905	0·396	42	0·009	3038	0·632	733	0·152	2305	0·480
+0·193	+0·196	+ 942	1993	0·415	42	0·009	2977	0·619	792	0·165	2185	0·455
+0·104	+0·106	+ 510	2034	0·423	42	0·009	2586	0·538	843	0·175	1743	0·363
+0·013	+0·014	+ 67	2089	0·435	42	0·009	2198	0·457	880	0·183	1318	0·274
−0·177	−0·179	− 860	2082	0·433	42	0·009	1264	0·263	873	0·182	391	0·081
−0·260	−0·263	−1264	2039	0·424	42	0·009	817	0·170	873	0·182	− 56	−0·012
−0·206	−0·208	−1000	2021	0·420	42	0·009	1063	0·221	855	0·178	208	0·043
−0·097	−0·098	− 471	1994	0·415	42	0·009	1565	0·326	823	0·171	742	0·154
−0·027	−0·027	− 130	1895	0·394	42	0·009	1807	0·376	779	0·162	1028	0·214
−0·006	−0·007	− 34	1779	0·370	42	0·009	1787	0·372	718	0·149	1069	0·222
+0·033	+0·031	+ 149	1711	0·356	42	0·009	1902	0·396	683	0·142	1219	0·254
+0·135	+0·138	+ 663	1749	0·364	42	0·009	2454	0·511	666	0·139	1788	0·372
+0·205	+0·210	+1010	1931	0·402	42	0·009	2983	0·621	712	0·148	2271	0·472
+0·253	+0·256	+1231	1962	0·408	42	0·009	3235	0·673	734	0·153	2501	0·520
+0·230	+0·233	+1120	1990	0·414	42	0·009	3152	0·656	810	0·169	2342	0·487
0·000	0·000	0	2075	0·432	42	0·009	2117	0·440	849	0·177	1268	0·264
−0·083	−0·085	− 409	2028	0·422	42	0·009	1661	0·346	880	0·183	781	0·162
−0·125	−0·127	− 610	2047	0·426	42	0·009	1479	0·308	917	0·191	562	0·117
−0·305	−0·308	−1481	2017	0·420	42	0·009	578	0·120	919	0·191	− 341	−0·071
−0·280	−0·282	−1356	1961	0·408	42	0·009	647	0·135	891	0·185	− 244	−0·051
			1952	0·406	42	0·009			803	0·167		

TABLE 26.

SUPPLY FACTORS OF LAKE ERIE.

Date.	Water Levels of Lake Erie.			Storage in Lake Erie.		Outflow through Niagara River. *a*		Total Supply to Lake Erie.		Inflow from Detroit River.		Local Supply to Lake Erie.	
	Cleveland, O.		Buffalo, N.Y.										
	First of Month.	Mean of Month.	Mean of Month.	Foot Depth,	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1860													
January		573·26	573·51			2321	2·19			2125	2·01		
February	573·08	2·90	2·93	+0·02	+ 21	2178	2·06	2199	2·08	1147	1·37	−752	+0·71
March	3·10	3·30	3·28	+0·55	+582	2265	2·14	2847	2·69	1942	1·84	+905	+0·86
April	3·65	4·00	3·91	+0·45	+746	2423	2·29	2899	2·74	2051	1·94	+848	+0·80
May	4·10	4·21	4·11	+0·10	+106	2475	2·34	2581	2·44	2214	2·09	+367	+0·35
June	4·20	4·18	4·15	−0·15	−159	2486	2·35	2327	2·20	2326	2·20	+ 1	0·00
July	4·05	3·92	3·96	−0·21	−222	2436	2·30	2214	2·09	2002	1·89	+212	+0·20
August	3·84	3·76	3·72	−0·25	−264	2375	2·25	2111	2·00	1995	1·89	+116	+0·11
September	3·59	3·42	3·44	−0·32	−338	2304	2·18	1966	1·86	1894	1·79	+ 72	+0·07
October	3·72	3·12	3·20	−0·19	−201	2244	2·12	2043	1·93	2376	2·25	−333	−0·31
November	3·08	3·03	3·22	−0·13	−137	2248	2·13	2111	2·00	1935	1·83	+176	+0·17
December	2·95	2·87	3·25	−0·21	−222	2256	2·13	2034	1·92	2250	2·13	−216	−0·20
1861													
January	2·74	2·61	2·86	−0·27	−286	2161	2·04	1875	1·77	*b*2306	2·18	−431	−0·41
February	2·47	2·33	2·36	+0·08	+ 85	2045	1·93	2130	2·01	1723	1·63	+407	+0·39
March	2·55	2·77	2·75	+0·74	+782	2136	2·02	2918	2·76	2166	2·05	+752	+0·71
April	3·29	3·81	3·72	+0·73	+772	2375	2·25	3147	2·98	2290	2·17	+857	+0·81
May	4·02	4·24	4·14	+0·26	+275	2485	2·35	2760	2·61	2164	2·05	+596	+0·56
June	4·28	4·31	4·28	−0·10	−106	2521	2·38	2415	2·28	2274	2·15	+141	+0·13
July	4·18	4·06	4·10	−0·10	−106	2474	2·34	2368	2·24	2324	2·20	+ 44	+0·04
August	4·08	4·10	4·06	−0·07	− 74	2463	2·33	2389	2·26	2409	2·28	− 20	−0·02
September	4·01	3·92	3·94	−0·21	−222	2431	2·30	2209	2·09	2358	2·23	−149	−0·14
October	3·80	3·69	3·77	−0·12	−127	2387	2·26	2260	2·14	2299	2·17	− 39	−0·04
November	3·68	3·67	3·86	−0·12	−127	2410	2·28	2283	2·16	2262	2·14	+ 21	+0·02
December	3·56	3·44	3·82	−0·12	−127	2401	2·27	2274	2·15	2264	2·14	+ 10	+0·01
1862													
January	3·44	3·43	3·68	−0·16	−169	2365	2·24	2196	2·08	2053	1·94	+143	+0·13
February	3·28	3·14	3·17	−0·07	− 74	2237	2·12	2163	2·05	1521	1·44	+642	+0·61
March	3·21	3·28	3·26	+0·52	+550	2258	2·14	2808	2·66	2024	1·91	+784	+0·74
April	3·73	4·18	4·09	+0·57	+603	2471	2·34	3074	2·91	2446	2·31	+628	−0·59

May	4·30	4·42	4·32	+0·12	+127	2531	2·39	2658	2·51	2358	2·23	+200	+0·28
June	4·42	4·42	4·39	−0·02	− 21	2551	2·41	2530	2·39	2393	2·26	+137	+0·13
July	4·40	4·39	4·43	−0·20	−211	2562	2·42	2351	2·22	2370	2·24	− 19	−0·02
August	4·20	4·01	3·97	−0·34	−360	2439	2·31	2079	1·97	2428	2·30	−349	−0·33
September	3·86	3·70	3·72	−0·35	−370	2375	2·25	2005	1·90	2411	2·28	−406	−0·38
October	3·51	3·32	3·40	−0·36	−381	2294	2·17	1913	1·81	2398	2·27	−485	−0·46
November	3·15	2·98	3·17	−0·15	−159	2237	2·12	2078	1·97	2362	2·23	−284	−0·27
December	3·00	3·01	3·39	+0·24	+254	2291	2·17	2545	2·41	2212	2·09	−333	−0·31
1863													
January	3·24	3·46	3·71	+0·36	+381	2372	2·24	2753	2·60	2153	2·04	+600	+0·57
February	3·60	3·75	3·78	+0·12	+127	2390	2·26	2517	2·38	2040	1·93	+477	+0·45
March	3·72	3·69	3·67	+0·03	+ 32	2361	2·23	2393	2·26	1878	1·78	+515	+0·49
April	3·75	3·81	3·72	+0·15	+159	2375	2·25	2534	2·40	2122	2·01	+412	+0·39
May	3·90	3·99	3·89	+0·02	+ 21	2418	2·29	2439	2·31	2307	2·18	+132	+0·12
June	3·92	3·85	3·82	−0·13	−137	2400	2·27	2263	2·14	2204	2·08	+ 59	+0·06
July	3·79	3·73	3·77	−0·10	−106	2387	2·26	2281	2·16	2340	2·21	− 59	−0·06
August	3·69	3·65	3·61	−0·23	−243	2346	2·22	2103	1·99	2336	2·21	−233	−0·22
September	3·46	3·26	3·28	−0·42	−444	2264	2·14	1820	1·72	2363	2·23	−543	−0·51
October	3·04	3·82	3·90	−0·42	−444	2172	2·05	1728	1·63	2202	2·08	−474	−0·45
November	2·62	2·41	2·60	−0·22	−233	2101	1·99	1868	1·77	2263	2·14	−395	−0·37
December	2·40	2·38	2·76	−0·16	−169	2137	2·02	1968	1·86	2187	2·07	−219	−0·21
1864													
January	2·24	2·09	2·34	−0·08	− 85	2041	1·93	1956	1·85	b2278	2·15	−322	−0·30
February	2·16	2·24	2·27	+0·18	+190	2025	1·92	2215	2·09	2043	1·93	+172	+0·16
March	2·34	2·45	2·43	+0·36	+381	2061	1·95	2442	2·31	2048	1·94	+394	+0·37
April	2·70	2·95	2·84	+0·60	+634	2157	2·04	2791	2·64	b2201	2·08	+590	+0·56
May	3·30	3·65	3·55	+0·32	+338	2332	2·21	2670	2·52	2309	2·18	+361	+0·34
June	3·62	3·60	3·57	−0·15	−159	2337	2·21	2178	2·06	2453	2·32	−275	−0·26
July	3·47	3·34	3·38	−0·27	−286	2288	2·16	2002	1·89	2376	2·25	−374	−0·35
August	3·20	3·07	3·03	−0·24	−254	2203	2·08	1949	1·84	2341	2·21	−392	−0·37
September	2·96	2·85	2·87	−0·26	−275	1165	2·05	1890	1·79	2310	2·18	−420	−0·40
October	2·70	2·54	2·62	−0·24	−254	2105	1·99	1851	1·75	2121	2·01	−270	−0·26
November	2·46	2·37	2·56	−0·06	− 63	2091	1·98	2028	1·92	2162	2·04	−134	−0·13
December	2·40	2·44	2·82	−0·18	−190	2153	2·04	1963	1·86	2133	2·02	−170	−0·16
1865													
January	572·22	272·01	572·26	−0·50	−529	2022	1·91	1493	1·41	1594	1·51	−101	−0·10
February	1·72	1·43	1·46	−0·13	−137	1846	1·75	1709	1·62	1446	1·37	−263	−0·25
March	1·59	1·75	1·73	+0·52	+550	1904	1·80	2454	2·32	1693	1·60	+761	+0·72
April	2·11	2·47	2·38	+0·65	+687	2050	1·94	2737	2·59	2092	1·98	+645	+0·61
May	2·76	3·05	2·95	+0·28	+296	2183	2·06	2479	2·34	2204	2·08	+275	+0·26
June	3·04	3·03	3·00	−0·03	− 32	2195	2·08	2163	2·05	2241	2·12	− 78	−0·07
July	3·01	2·99	3·03	−0·06	− 63	2203	2·08	2140	2·02	2333	2·21	−193	−0·18
August	2·95	2·91	2·87	−0·06	− 63	2165	2·05	2102	1·99	2340	2·21	−238	−0·23
Sept.	2·89	2·87	2·89	−0·17	−180	2171	2·05	1991	1·88	2321	2·19	−330	−0·31
October	2·72	2·57	2·65	−0·34	−360	2112	2·00	1752	1·66	2276	2·15	−524	−0·50
November	2·38	2·19	2·38	−0·26	−275	2050	1·94	1775	1·68	2179	2·06	−404	−0·38
December	2·12	2·05	2·43	−0·20	−211	2061	1·95	1850	1·75	2087	1·97	−237	−0·22

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

Date.	Water Levels of Lake Erie.			Storage in Lake Erie.		Outflow through Niagara River. *a*		Supply to Lake Erie.		Inflow from Detroit River.		Supply to Lake Erie. Local	
	Cleveland, O.		Buffalo, N.Y.										
	First of Month.	Mean of Month.	Mean of Month.	Foot Depth,	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1866													
January	1·92	1·78	2·03	−0·22	−233	1971	1·86	1738	1·64	*b*2026	1·92	−288	−0·27
February	1·70	1·62	1·65	+0·12	+127	1887	1·78	2014	1·90	1928	1·82	+ 86	−0·08
March	1·82	2·01	1·99	+0·48	+508	1962	1·86	2470	2·34	1850	1·75	+620	+0·59
April	2·30	2·59	2·50	+0·40	+423	2077	1·96	2500	2·36	*b*1964	1·87	+536	+0·51
May	2·70	2·81	2·71	+0·24	+254	2125	2·01	2379	2·25	2098	1·98	+281	+0·27
June	2·94	3·07	3·04	+0·18	+190	2206	2·09	2396	2·27	2183	2·06	+213	+0·20
July	3·12	3·18	3·22	−0·06	− 63	2248	2·13	2185	2·07	2268	2·14	− 83	−0·08
August	3·06	2·93	2·89	−0·16	−169	2169	2·05	2000	1·89	2256	2·13	−256	−0·24
September	2·90	2·87	2·89	−0·04	− 42	2169	2·05	2127	2·01	2243	2·12	−116	−0·11
October	2·86	2·86	2·94	−0·12	−127	2181	2·06	2054	1·94	2228	2·11	−174	−0·16
November	2·74	2·62	2·81	−0·12	−127	2150	2·03	2023	1·91	2295	2·17	−272	−0·26
December	2·62	2·63	3·01	−0·14	−148	2197	2·08	2049	1·94	2272	2·15	−223	−0·21
1867													
January	2·48	2·34	2·59	−0·30	−317	2098	1·98	1781	1·68	1881	1·78	−100	−0·09
February	2·18	2·02	2·05	+0·04	+ 42	1075	1·87	2017	1·91	1996	1·89	+ 21	+0·02
March	2·22	2·42	2·40	+0·36	+381	2055	1·94	2436	2·30	1641	1·55	−795	+0·75
April	2·58	2·74	2·65	+0·42	+444	2112	2·00	2556	2·42	*b*2118	2·00	+438	+0·41
May	3·00	3·26	3·16	+0·42	+444	2234	2·11	2678	2·53	2299	2·17	+379	+0·36
June	3·42	3·57	3·54	+0·06	+ 63	2330	2·20	2393	2·26	2427	2·30	− 34	−0·03
July	3·48	3·38	3·42	−0·26	−275	2298	2·17	2023	1·91	2381	2·25	−358	−0·34
August	3·22	3·07	3·03	−0·34	−360	2203	2·08	1843	1·74	2420	2·29	−577	−0·55
September	2·88	2·68	2·70	−0·37	−391	2123	2·01	1732	1·64	2337	2·21	−605	−0·57
October	2·51	2·34	2·42	−0·42	−444	2058	1·95	1614	1·53	2231	2·11	−617	−0·58
November	2·09	1·84	2·03	−0·36	−381	1970	1·86	1589	1·50	2154	2·04	−565	−0·53
December	1·73	1·62	2·00	−0·21	−222	1864	1·86	1742	1·65	2093	1·98	−351	−0·33
1868													
January	1·52	1·42	1·67	−0·29	−307	1891	1·79	1584	1·50	*b*2042	1·93	−458	−0·43
February	1·23	1·04	1·07	+0·11	+116	1765	1·67	1881	1·78	1733	1·64	+148	+0·14
March	1·34	1·63	1·61	+0·70	+740	1878	1·78	2618	2·48	2117	2·06	+439	+0·42
April	2·04	2·46	2·37	+0·64	+677	2048	1·94	2725	2·58	2095	1·98	+630	+0·60

May	2·68	2·91	2·81	+0·42	+444	2149	2·03	2593	2·45	2209	2·09	+384	+0·36
June	3·10	3·30	3·27	+0·18	+190	2261	2·14	2451	2·32	2266	2·14	+185	+0·17
July	3·28	3·27	3·31	+0·27	−286	2270	2·15	1984	1·88	2211	2·09	−227	−0·21
August	3·01	2·75	2·71	−0·39	−412	2125	2·01	1713	1·62	2180	2·06	−467	−0·44
September	2·62	2·48	2·50	−0·36	−381	2077	1·96	1696	1·60	2146	2·03	−450	−0·43
October	2·26	2·03	2·11	−0·31	−328	1987	1·88	1659	1·57	2064	1·95	−405	−0·38
November	1·95	1·87	2·06	−0·19	−201	1976	1·87	1775	1·68	2016	1·91	−241	−0·23
December	1·76	1·66	2·04	−0·10	−106	1973	1·87	1867	1·77	1998	1·89	−131	−0·12
1869													
January	1·66	1·65	1·90	−0·04	− 42	1941	1·84	1899	1·80	1844	1·74	+ 55	+0·05
February	1·62	1·58	1·61	+0·20	+211	1878	1·78	2089	1·98	1692	1·60	+397	+0·38
March	1·82	2·06	2·04	+0·39	+412	1973	1·87	2385	2·26	1607	1·52	+778	+0·74
April	2·21	2·36	2·27	+0·43	+455	2025	1·92	2480	2·35	1976	1·87	+504	+0·48
May	2·64	2·91	2·81	+0·46	+486	2149	2·03	2635	2·49	1848	1·75	+787	+0·74
June	3·10	3·30	3·27	+0·34	+360	2261	2·14	2621	2·48	2030	1·92	+591	+0·56
July	3·44	3·58	3·62	+0·09	+ 95	2348	2·22	2443	2·31	2184	2·07	+259	+0·24
August	3·53	3·48	3·44	−0·19	−201	2304	2·18	2103	1·99	2211	2·09	−108	−0·10
September	3·34	3·21	3·23	−0·36	−381	2251	2·13	1870	1·77	2192	2·07	−322	−0·30
October	2·98	2·76	2·84	−0·45	−476	2157	2·04	1681	1·59	2091	1·98	−410	−0·39
November	2·53	2·30	2·49	−0·05	− 53	2075	1·96	2022	1·91	2121	2·01	− 99	−0·09
December	2·48	2·65	3·03	+0·29	+307	2203	2·08	2510	2·37	2133	2·02	+377	+0·36
1870													
January	572·77	572·89	573·14	+0·23	+ 243	2229	2·11	2472	2·34	b2021	1·91	+ 451	+0·43
February	3·00	3·12	3·15	0·00	0	2231	2·11	2231	2·11	1757	1·66	+ 474	+0·45
March	3·00	2·89	2·87	+0·22	+ 233	2164	2·05	2397	2·27	1853	1·75	+ 544	+0·51
April	3·22	3·54	3·45	+0·42	+ 444	2306	2·18	2750	2·60	2154	2·04	+ 596	+0·56
May	3·64	3·75	3·65	+0·10	+ 106	2356	2·23	2462	2·33	2212	2·09	+ 250	+0·24
June	3·74	3·72	3·69	0·00	0	2368	2·24	2368	2·24	2354	2·23	+ 14	+0·01
July	3·74	3·76	3·80	0·00	0	2395	2·26	2395	2·26	2456	2·32	− 61	−0·06
August	3·74	3·71	3·67	−0·16	− 169	2361	2·23	2192	2·07	2431	2·30	− 239	−0·23
September	3·58	3·46	3·48	−0·31	− 328	2314	2·19	1986	1·88	2373	2·24	− 387	−0·37
October	3·27	3·08	3·16	−0·34	− 360	2234	2·11	1874	1·77	2248	2·13	− 374	−0·35
November	2·93	2·78	2·97	−0·21	− 222	2188	2·07	1966	1·86	2248	2·13	− 282	−0·27
December	2·72	2·66	3·04	−0·16	− 169	2206	2·09	2037	1·93	2210	2·09	− 173	−0·16
1871													
January	2·56	2·45	2·70	−0·28	− 296	2123	2·01	1827	1·73	2059	1·95	− 232	−0·22
February	2·28	2·12	2·15	+0·06	+ 63	1997	1·89	2060	1·95	1679	1·59	+ 381	+0·36
March	2·34	2·57	2·55	+0·47	+ 497	2088	1·97	2585	2·44	b2257	2·13	+ 328	+0·31
April	2·81	3·05	2·96	+0·37	+ 391	2185	2·07	2576	2·44	2370	2·24	+ 206	+0·19
May	3·18	3·32	3·22	+0·16	+ 169	2248	2·13	2417	2·29	2429	2·30	− 12	−0·01
June	3·34	3·35	3·32	0·00	0	2273	2·15	2273	2·15	2463	2·33	− 190	−0·18
July	3·34	3·33	3·37	−0·12	− 127	2285	2·16	2158	2·04	2466	2·33	− 308	−0·29
August	3·22	3·12	3·08	−0·18	− 190	2215	2·09	2025	1·92	2415	2·28	− 390	−0·37
September	3·04	2·95	2·97	−0·42	− 444	2188	2·07	1744	1·65	2319	2·19	− 575	−0·54
October	2·62	2·28	2·36	−0·43	− 455	2045	1·93	1590	1·50	2186	2·07	− 596	−0·56
November	2·19	2·10	2·29	−0·31	− 328	2029	1·92	1701	1·61	2174	2·06	− 473	−0·45
December	1·88	1·66	2·04	−0·26	− 275	1973	1·87	1698	1·61	2334	2·21	− 636	−0·60

a.—Discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

Date.	Water Levels of Lake Erie.			Storage in Lake Erie.		Outflow tdrough Niagara River. a		Supply to Lake Rrie.		Inflow from Detroit River.		Supply to Lake Erie. Local	
	Cleveland, O.		Buffalo, N.Y.				Feet				Feet		
	First of Month.	Mean Month.	Mean of Month.	Foot Depth,	c.f.s.	c.f.s.	Lake Erie.	c.f.s.	Depth.	c.f.s.	Lake Erie.	c.f.s.	Depth.
1872													
January	1·62	1·58	1·83	−0·16	− 169	1925	1·82	1756	1·66	1995	1·89	− 239	−0·23
Februray	1·46	1·34	1·37	−0·16	− 169	1828	1·73	1659	1·57	2032	1·92	− 373	−0·35
March	1·30	1·25	1·23	+0·05	+ 53	1798	1·70	1851	1·75	1936	1·83	− 85	−0·08
April	1·35	1·45	1·36	+0·32	+ 338	1825	1·73	2163	2·05	*b*1996	1·89	+ 167	+0·16
May	1·67	1·89	1·79	+0·41	+ 434	1917	1·81	2351	2·22	2100	1·99	+ 251	+0·24
June	2·08	2·26	2·23	+0·18	+ 190	2016	1·91	2206	2·09	2217	2·10	− 11	−0·01
July	2·26	2·25	2·29	−0·02	− 21	2029	1·92	2008	1·90	2059	1·95	− 51	−0·05
August	2·24	2·22	2·18	−0·14	− 148	2005	1·90	1857	1·76	2132	2·02	− 275	−0·26
September	2·10	1·99	2·01	−0·20	− 211	1966	1·86	1755	1·66	2126	2·01	− 371	−0·35
October	1·90	1·82	1·90	−0·24	− 254	1941	1·84	1687	1·60	2146	2·03	− 459	−0·43
November	1·66	1·49	1·68	−0·28	− 296	1893	1·79	1597	1·51	2024	1·91	− 427	−0·40
December	1·38	1·26	1·64	−0·17	− 180	1885	1·78	1705	1·61	2005	1·90	− 300	−0·28
1873													
January	1·21	1·16	1·41	−0·05	− 53	1835	1·74	1782	1·69	1769	1·70	− 14	−0·01
February	1·16	1·17	1·20	+0·04	+ 42	1792	1·69	1834	1·73	1924	1·82	− 90	−0·09
March	1·20	1·24	1·22	+0·68	+ 719	1796	1·70	2515	2·38	2069	1·96	+ 446	+0·42
April	1·88	2·52	2·43	+0·98	+1·036	2061	1·95	3097	2·93	1991	1·88	+ 1106	+1·05
May	2·86	3·19	3·09	+0·37	+ 391	2217	2·10	2608	2·47	*b*1997	1·89	+ 611	+0·58
June	3·23	3·27	3·24	+0·03	+ 32	2255	2·13	2287	2·16	2133	2·02	+ 154	+0·15
July	3·26	3·25	3·29	−0·04	− 42	2267	2·14	2225	2·10	2195	2·08	+ 30	+0·03
August	3·22	3·19	3·15	−0·23	− 243	2231	2·11	1988	1·88	2201	2·08	− 213	−0·20
September	2·99	2·79	2·81	−0·35	− 370	2150	2·03	1780	1·68	2202	2·08	− 422	−0·40
October	2·64	2·49	2·57	−0·25	− 264	2094	1·98	1830	1·73	2141	2·02	− 311	−0·29
November	2·39	2·29	2·48	+0·09	+ 95	2072	1·96	2167	2·05	2134	2·02	+ 33	+0·03
December	2·48	2·66	3·04	+0·38	+ 402	2206	2·09	2608	2·47	2067	1·95	+ 541	+0·51
1874													
January	2·86	3·05	3·30	+0·22	+ 233	2269	2·15	2502	2·37	1470	1·39	+ 1032	+0·98
February	3·08	3·10	3·13	+0·04	+ 42	2227	2·11	2269	2·15	1053	1·00	+ 1216	+1·15
March	3·12	3·13	3·11	+0·10	+ 106	2221	2·10	2327	2·20	1947	1·84	+ 380	+0·36
April	3·22	3·30	3·21	+0·12	+ 127	2246	2·12	2373	2·24	2053	1·94	+ 320	+0·30

May	3·34	3·39	3·29	+0·08	+ 85	2267	2·14	2352	2·22	1998	1·89	+ 354	+0·33
June	3·42	3·46	3·43	+0·06	+ 63	2301	2·18	2364	2·24	2106	1·99	+ 258	+0·24
July	3·48	3·49	3·53	−0·07	− 74	2327	2·20	2253	2·13	2168	2·05	+ 85	+0·08
August	3·41	3·33	3·29	−0·31	− 328	2267	2·14	1939	1·83	2164	2·05	− 225	−0·21
September	3·10	2·87	2·89	−0·45	− 476	2170	2·05	1694	1·60	2200	2·08	− 506	−0·48
October	2·65	2·43	2·51	−0·43	− 455	2079	1·97	1624	1·54	2185	2·07	− 561	−0·53
November	2·22	2·10	2·20	−0·32	− 338	2009	1·90	1671	1·58	2183	2·06	− 512	−0·48
December	1·90	1·80	2·18	−0·22	− 233	2005	1·90	1772	1·68	2027	1·92	− 255	−0·24
1875													
January	571·68	571·57	571·82	−0·20	− 211	1923	1·82	1712	1·62	2008	1·90	− 296	−0·28
February	1·48	1·40	1·43	−0·01	− 11	1840	1·74	1829	1·73	2045	1·93	−216	−0·20
March	1·47	1·54	1·52	+0·27	+ 286	1860	1·76	2146	2·03	2093	1·98	+ 53	+0·05
April	1·74	1·94	1·85	+0·44	+ 465	1929	1·82	2394	2·26	2027	1·92	+ 367	+0·35
May	2·18	2·41	2·31	+0·44	+ 465	2033	1·92	2498	2·36	2187	2·07	+ 311	+0·29
June	2·62	2·84	2·81	+0·28	+ 296	2149	2·03	2445	2·31	2157	2·04	+ 288	+0·27
July	2·90	2·97	3·01	+0·06	+ 63	2197	2·08	2260	2·14	2218	2·10	+ 42	+0·04
August	2·96	2·96	2·92	−0·07	− 74	2176	2·06	2102	1·99	2175	2·06	− 73	−0·07
September	2·89	2·82	2·84	−9·31	− 328	2157	2·04	1829	1·73	2140	2·02	− 311	−0·29
October	2·58	2·33	2·41	−0·32	− 338	2056	1·94	1718	1·62	2177	2·06	− 459	−0·43
November	2·26	2·18	2·37	+0·03	+ 32	2047	1·94	2079	1·97	2158	2·04	− 79	−0·07
December	2·29	2·40	2·78	+0·09	+ 95	2143	2·03	2238	2·12	1908	1·87	+ 258	+0·24
1876													
January	2·38	2·36	2·61	+0·26	+ 275	2102	1·99	2377	2·25	2060	1·95	+ 317	+0·30
February	2·64	2·92	2·95	+0·60	+ 634	2183	2·06	2817	2·66	2160	2·04	+ 657	+0·62
March	3·24	3·57	3·55	+0·59	+ 624	2332	2·21	2956	2·80	b2188	2·07	+ 768	+0·73
April	3·83	4·09	4·00	+0·42	+ 444	2446	2·31	2890	2·73	2240	2·12	+ 650	+0·61
May	4·25	4·41	4·31	+0·21	+ 222	2528	2·39	2750	2·60	1955	1·85	+ 795	+0·75
June	4·46	4·52	4·49	0·00	0	2578	2·44	2578	2·44	2511	2·37	+ 67	+0·06
July	4·46	4·41	4·45	−0·20	− 211	2567	2·43	2356	2·23	2627	2·48	− 271	−0·26
August	4·26	4·11	4·07	−0·24	− 254	2465	2·33	2211	2·09	2618	2·48	− 407	−0·38
September	4·02	3·94	3·96	−0·34	− 360	2435	2·30	2075	1·96	2389	2·26	− 314	−0·30
October	3·68	3·41	3·49	−0·23	− 243	2317	2·19	2074	1·96	2352	2·22	− 278	−0·26
November	3·45	3·49	3·68	−0·13	− 137	2365	2·24	2228	2·11	2300	2·18	− 72	−0·07
December	3·32	3·15	3·53	−0·37	− 391	2327	2·20	1936	1·83	b2283	2·16	− 347	−0·33
1877													
January	2·95	2·75	3·00	−0·28	− 296	2196	2·08	1900	1·80	b2371	2·24	− 471	−0·45
February	2·67	2·59	2·62	−0·19	− 201	2105	1·99	1904	1·80	1947	1·84	− 43	−0·04
March	2·48	2·36	2·34	+0·10	+ 106	2041	1·93	2147	2·03	1342	1·27	+ 805	+0·76
April	2·58	2·79	2·70	+0·34	+ 360	2124	2·01	2484	2·35	1753	1·66	+ 731	+0·69
May	2·92	3·04	2·94	+0·16	+ 169	2181	2·06	2350	2·22	1799	1·70	+ 551	+0·52
June	3·08	3·12	3·09	+0·16	+ 169	2217	2·10	2386	2·26	2251	2·13	+ 135	+0·13
July	3·24	3·36	3·40	+0·05	+ 53	2294	2·17	2347	2·22	2290	2·17	+ 57	+0·05
August	3·29	3·22	3·18	−0·11	− 116	2239	2·12	2123	2·01	2277	2·15	− 154	−0·15
September	3·18	3·14	3·16	−0·24	− 254	2234	2·11	1980	1·87	2164	2·05	− 184	−0·17
October	2·94	2·74	2·82	−0·24	− 254	2152	2·04	1898	1·79	2232	2·11	− 334	−0·32
November	2·70	2·66	2·85	0·00	0	2159	2·04	2159	2·04	1943	1·84	+ 216	+0·20
December	2·70	2·74	3·12	+0·08	+ 85	2225	2·10	2310	2·19	2149	2·03	+ 161	+0·15

a.—Discharge values include a flow of 1,000 c.f. s. through Erie Canal and 1,100 c. f. s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

Date.	Water Levels of Lake Erie.			Storage in Lake Erie.		Outflow through Niagara River. *a*		Supply to Lake Erie.		Inflow from Detroit River.		Supply to Lake Erie. Local	
	Cleveland, O.		Buffalo, N.Y.										
	First of Month.	Mean of Month.	Mean of Month.	Foot Depth,	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1878													
January	2·78	2·82	3·07	+0·11	+ 116	2213	2·09	2329	2·20	2054	1·94	+ 275	+0·26
February	2·89	2·96	2·99	+0·13	+ 137	2195	2·08	2332	2·21	1518	1·44	+ 814	+0·77
March	3·02	3·09	3·07	+0·28	+ 296	2213	2·09	2509	2·37	1566	1·48	+ 943	+0·89
April	3·30	3·51	3·42	+0·33	+ 349	2298	2·17	2647	2·50	2217	2·10	+ 430	+0·41
May	3·63	3·75	3·65	+0·12	+ 127	2356	2·23	2483	2·35	2231	2·11	+ 252	+0·24
June	3·75	3·75	3·75	0·00	0	2375	2·25	2375	2·25	227	2·15	+ 104	+0·10
July	3·75	3·75	3·79	−0·11	− 116	2393	2·26	2277	2·15	2316	2·19	− 39	−0·04
August	3·64	3·53	3·49	−0·18	− 190	2317	2·19	2127	2·01	2330	2·20	− 203	−0·19
September	3·46	3·40	3·42	−0·24	− 254	2298	2·17	2044	1·93	2178	2·06	+ 134	−0·13
October	3·22	3·05	3·13	−0·27	− 286	2227	2·11	1941	1·84	2168	2·05	− 227	−0·21
November	2·95	2·85	3·04	−0·06	− 63	2206	2·09	2143	2·03	2088	1·97	+ 55	+0·05
December	2·89	2·93	3·31	−0·17	− 180	2271	2·15	2091	1·98	1855	1·75	+ 236	+0·22
1879													
January	2·72	2·51	2·76	−0·28	− 296	2137	2·02	1811	1·74	1771	1·67	+ 70	+0·07
February	2·44	2·37	2·40	−0·06	− 63	2055	1·91	1992	1·88	1482	1·40	+ 510	+0·48
March	2·38	2·40	2·38	+0·20	+ 211	2051	1·94	2262	2·11	1849	1·75	+ 413	+0·39
April	2·58	2·76	2·67	+0·26	+ 275	2118	2·00	2393	2·26	2062	1·96	+ 331	+0·31
May	2·84	2·91	2·81	+0·12	+ 127	2149	2·03	2276	2·15	1950	1·84	+ 326	+0·31
June	2·96	3·00	2·97	+0·06	+ 63	2187	2·07	2250	2·13	2078	1·97	+ 172	+0·16
July	3·02	3·03	3·07	−0·10	− 106	2213	2·09	2107	1·99	2104	1·99	+ 3	0·00
August	2·92	2·81	2·77	−0·28	− 296	2140	2·02	1844	1·74	2052	1·94	− 208	−0·20
September	2·64	2·48	2·50	−0·28	− 296	2077	1·96	1781	1·68	2058	1·95	− 277	−0·26
October	2·36	2·25	2·33	−0·34	− 360	2038	1·93	1678	1·59	1961	1·85	− 283	−0·27
November	2·02	1·78	1·97	−0·11	− 116	1956	1·85	1840	1·74	1978	1·87	− 138	−0·13
December	1·91	2·04	2·42	+0·38	+ 402	2059	1·95	2461	2·33	1956	1·85	+ 505	+0·48
1880													
January	572·29	572·51	572·79	+0·27	+ 286	2146	2·03	2132	2·30	1931	1,83	+ 501	+0·47
February	2·56	2·58	2·61	+0·09	+ 95	2103	1·99	2198	2·08	1709	1·62	+ 489	+0·46
March	2·65	2·72	2·70	+0·15	+ 159	2124	2·01	2283	2·16	1903	1·80	+ 380	+0·36
April	2·80	2·88	2·79	+0·22	+ 233	2145	2·03	2378	2·25	1974	1·87	+ 401	+0·38

May	3·02	3·05	3·15	+0·18	+ 190	2207	2·09	2397	2·27	1983	1·88	+ 414	+0·39
June	3·20	3·26	3·23	+0·10	+ 106	2251	2·13	2357	2·23	2176	2·06	+ 181	+0·17
July	3·30	3·35	3·39	−0·07	− 74	2291	2·17	2217	2·10	2095	1·98	+ 122	+0·12
August	3·23	3·11	3·07	−0·23	− 243	2213	2·09	1970	1·86	2216	2·10	− 246	−0·23
September	3·00	2·88	2·90	−0·34	− 360	2172	2·05	1812	1·71	2153	2·04	− 341	−0·32
October	2·66	2·41	2·52	−0·26	− 275	2081	1·97	1806	1·71	2089	1·98	− 283	−0·27
November	2·40	2·36	2·55	−0·21	− 222	2088	1·97	1866	1·76	2058	1·95	− 192	−0·18
December	2·19	2·02	2·40	−0 37	− 391	2055	1·94	1664	1·57	2054	1·94	− 390	−0·37
1881													
January	1·82	1·61	1·86	−0·16	− 169	1931	1·83	1762	1·67	1756	1·66	+ 6	+0·01
February	1·66	1·72	1·75	+0·22	+ 233	1908	1·80	2141	2·02	1968	1·86	+ 173	+0·16
March	1·88	2·04	2·02	+0·51	+ 539	1968	1·86	2507	2·37	1891	1·79	+ 616	+0·58
April	2·39	2·74	2·65	+0·55	+ 582	2112	2·00	2694	2·55	2025	1·92	+ 669	+0·63
May	2·94	3·14	3·04	+0·32	+ 338	2205	2·09	2543	2·40	2083	1·97	+ 460	+0·44
June	3·26	3·38	3·35	+0·10	+ 106	2281	2·16	2387	2·26	2182	2·06	+ 205	+0·19
July	3·36	3·33	3·37	−0·19	− 201	2286	2·16	2085	1·97	2178	2·06	− 93	−0·09
August	3·17	3·01	2·97	−0·33	− 349	2188	2·07	1839	1·74	2209	2·09	− 370	−0·35
September	2·84	2·66	2·68	−0·20	− 211	2119	2·00	1908	1·80	2247	2·12	− 339	−0·32
October	2·64	2·61	2·69	−0·12	− 127	2121	2·01	1994	1·89	2137	2·02	− 143	−0·14
November	2·52	2·43	2·62	+0·02	+ 21	2105	1·99	2126	2·01	2288	2·16	− 162	−0·15
December	2·54	2·64	3·02	+0·34	+ 360	2200	2·08	2560	2·42	2232	2,11	+ 32	+0·31
1882													
January	2·88	3·11	3·36	+0·23	+ 243	2283	2·16	2526	2·39	2225	2·10	+ 301	+0·28
February	3·11	3·11	3·14	+0·23	+ 243	2229	2·11	2472	2·34	2045	1·93	+ 427	+0·40
March	3·34	3·56	3·54	+0·33	+ 349	2330	2·30	2679	2·53	2194	2·07	+ 485	+0·46
April	3·67	3·78	3·69	+0·21	+ 222	2367	2·24	2589	2 45	2182	2·06	+ 407	+0·38
May	3·88	3·98	3·88	+0·18	+ 190	2416	2·28	2606	2·46	2368	2·24	+ 238	+0·23
June	4·06	4·13	4·10	+0·04	+ 42	2474	2·34	2516	2·38	2206	2·09	+ 310	+0·29
July	4·10	4·06	4·10	−0·11	− 116	2474	2·34	2358	2·23	2580	2·44	− 222	−0·21
August	3·99	3·92	3·88	−0·21	− 222	2416	2·28	2194	2·07	2615	2·47	− 421	−0·40
September	3·78	3·65	3·67	−0·36	− 381	2362	2·23	1981	1·87	2321	2·19	− 340	−0·32
October	3·42	3·20	3·28	−0·38	− 402	2265	2·14	1863	1·76	2271	2·15	− 408	−0·39
November	3·04	2·88	3·07	−0·42	− 444	2213	2·09	1769	1·67	2251	2·13	− 482	−0·46
December	2·62	2·37	2·75	−0·30	− 317	2135	2·02	1818	1·72	*b*2139	2·02	− 321	−0·30
1883													
January	2·32	2·28	2·53	+0·06	+ 63	2084	1·97	2147	2·03	2238	2·12	− 91	−0·09
February	2·38	2·49	2·52	+0·20	+ 211	2081	1·97	2292	2·17	2228	2·11	+ 64	+0·06
March	2·58	2·68	2·66	+0·16	+ 169	2115	2·00	2284	2·16	1856	1·76	+ 428	+0·40
April	2·74	2·80	2·71	+0·29	+ 307	2126	2·01	2433	2·30	2156	2·04	+ 277	+0·26
May	3·03	3·26	3·16	+0·58	+ 613	2234	2·11	2847	2·69	2230	2·11	+ 617	+0·58
June	3·61	3·96	3·93	+0·45	+ 476	2427	2·30	2903	2·75	2434	2·30	+ 469	+0·44
July	4·06	4·16	4·20	+0·07	+ 74	2500	2·36	2574	2·43	2754	2·60	− 180	−0·17
August	4·13	4·10	4·06	−0·19	− 201	2462	2·33	2261	2·14	2716	2·57	− 455	−0·43
September	3·94	3·79	3·81	−0·31	− 328	2397	2·27	2069	1·96	2538	2·40	− 469	−0·44
October	3·63	3·47	3·55	−0·35	− 370	2332	2·21	1962	1·86	2402	2·27	− 440	−0·42
November	3·28	3·09	3·28	−0·18	− 190	2265	2·14	2075	1·96	2307	2·18	− 232	−0·22
December	3·10	3·12	3·50	−0·14	− 148	2320	2·19	2172	2·05	2211	2·09	− 39	−0·04

a.—Discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

Date.	WATER LEVELS OF LAKE ERIE.			STORAGE IN LAKE ERIE.		OUTFLOW THROUGH NIAGARA RIVER. *a*		SUPPLY TO LAKE ERIE.		INFLOW FROM DETROIT RIVER.		LOCAL SUPPLY TO LAKE ERIE.	
	Cleveland, O.		Buffalo, N.Y.										
	First of Month.	Mean of Month.	Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1884													
January	2·96	2·79	3·04	−0·04	− 42	2206	2·09	2164	2·05	1514	1,43	+ 650	+0·61
February	2·92	3·05	3·08	+0·22	+ 233	2215	2·09	2448	2·32	1703	1·61	+ 745	+0·70
March	3·14	3·24	3·22	+0·38	+ 402	2248	2·13	2650	2·51	2426	2·29	+ 224	+0·21
April	3·52	3·79	3·70	+0·40	+ 423	2370	2·24	2793	2·64	2428	2·30	+ 365	+0·35
May	3·92	4·06	3·96	+0·18	+ 190	2436	2·30	2626	2·48	2444	2·31	+ 182	+0·17
June	4·10	4·14	4·11	−0·07	− 74	2475	2·34	2401	2·27	2531	2·39	− 130	−0·12
July	4·03	3·92	3·96	−0·19	− 201	2436	2·30	2235	2·11	2611	2·47	− 376	−0·36
August	3·84	3·76	3·72	−0·30	− 317	2375	2·25	2058	1·95	2489	2·35	− 431	−0·41
September	3·54	3·33	3·35	−0·38	− 402	2281	2·16	1879	1·78	2410	2·28	− 531	−0·50
October	3·16	3·00	3·08	−0·40	− 423	2215	2·09	1792	1·69	2367	2·24	− 575	−0·54
November	2·76	2·52	2·71	−0·28	− 296	2126	2·01	1830	1·73	2336	2·21	− 506	−0·48
December	2·48	2·45	2·83	−0·12	− 127	2155	2·04	2028	1·92	2384	2·25	− 356	−0·34
1885													
January	572·36	572·27	572·52	−0·20	− 211	2081	1·97	1870	1·77	*b*2398	2·27	− 528	−0·50
February	2·16	2·06	2·09	−0·17	− 180	1984	1·88	1804	1·71	2352	2·22	− 548	−0·52
March	1·99	1·92	1·90	+0·34	+ 360	1941	1·84	2301	2·18	*b*2364	2·24	− 63	−0·06
April	2·33	2·74	2·65	+0·77	+ 814	2112	2·00	2926	2·77	*b*2287	2·15	+ 639	+0·60
May	3·10	3·47	3·37	+0·62	+ 656	2286	2·16	2942	2·78	2386	2·26	+ 556	+0·53
June	3·72	3·98	3·95	+0·24	+ 254	2434	2·30	2688	2·54	2445	2·31	+ 243	+0·23
July	3·96	3·94	3·98	−0·02	− 21	2441	2·31	2420	2·29	2376	2·25	+ 44	+0·04
August	3·94	3·95	3·91	−0·06	− 63	2423	2·29	2360	2·23	2432	2·30	− 72	−0·07
September	3·88	3·80	3·82	−0·13	− 137	2400	2·27	2263	2·14	2396	2·27	− 133	−0·13
October	3·75	3·70	3·78	−0·11	− 116	2390	2·26	2274	2·15	2217	2·10	+ 57	+0·05
November	3·64	3·58	3·77	−0·08	− 85	2387	2·26	2302	2·18	2276	2·15	+ 26	+0·02
December	3·56	3·53	3·91	−0·02	− 21	2423	2·29	2402	2·27	2204	2·08	+ 198	+0·19
1886													
January	3·54	3·55	3·80	−0·36	− 381	2395	2·26	2014	1·90	1677	1·59	+ 337	+0·32
February	3·18	2·82	2·85	−0·46	− 486	2159	2·04	1673	1·58	1490	1·41	+ 183	+0·17
March	2·72	2·63	2·61	+0·35	+ 370	2103	1·99	2473	2·34	2008	1·90	+ 465	+0·44
April	3·07	3·51	3·42	+0·59	+ 624	2298	2·17	2922	2·76	2118	2·00	+ 804	+0·76

May	3·66	3·81	3·71	+0·20	+ 211	2372	2·24	2583	2·44	2428	2·30	+ 155	+0·15
June	3·86	3·91	3·88	+0·04	+ 42	2416	2·28	2458	2·32	2432	2·30	+ 26	+0·02
July	3·90	3·89	3·93	−0·11	− 116	2428	2·30	2312	2·19	2418	2·29	− 106	−0·10
August	3·79	3·69	3·65	−0·23	− 243	2357	2·23	2114	2·00	2406	2·28	− 292	−0·28
September	3·56	3·44	3·46	−0·24	− 254	2307	2·18	2053	1·94	2403	2·27	− 350	−0·33
October	3·32	3·21	3·29	−0·26	− 275	2267	2·14	1992	1·88	2364	2·24	− 372	−0·35
November	3·06	2·92	3·11	−0·18	− 190	2222	2·10	2032	1·92	2298	2·17	− 266	−0·25
December	2·88	2·83	3·21	−0·16	− 169	2240	2·12	2077	1·96	2403	2·27	− 326	−0·31
1887													
January	2·72	2·61	2·86	+0·10	+ 106	2161	2·04	2267	2·14	2289	2·16	− 22	−0·02
February	2·82	3·04	3·07	+0·61	+ 645	2212	2·09	2857	2·70	2253	2·13	+ 604	+0·57
March	3·43	3·82	3·75	+0·41	+ 434	2383	2·25	2817	2·66	1985	1·88	+ 832	+0·79
April	3·84	3·87	3·71	+0·12	+ 127	2372	2·24	2499	2·36	2133	2·02	+ 366	+0·35
May	3·96	4·05	3·93	+0·10	+ 106	2427	2·30	2533	2·40	2202	2·08	+ 331	+0·31
June	4·06	4·07	4·07	−0·10	− 106	2465	2·33	2359	2·23	2261	2·14	+ 98	+0·09
July	3·96	3·84	3·91	−0·28	− 296	2423	2·29	2127	2·01	2319	2·19	− 192	−0·18
August	3·68	3·52	3·51	−0·28	− 296	2322	2·20	2026	1·92	2316	2·19	− 290	−0·27
September	3·40	3·29	3·20	−0·40	− 423	2244	2·12	1821	1·72	2233	2·11	− 412	−0·39
October	3·00	2·70	3·26	−0·44	− 465	2258	2·14	1793	1·70	2217	2·10	− 424	−0·40
November	2·56	2·43	2·71	−0·12	− 127	2125	2·01	1998	1·89	2109	1·99	− 111	−0·10
December	2·44	2·45	2·89	−0·08	− 85	2170	2·05	2085	1·97	2016	1·91	+ 69	+0·07
1888													
January	2·36	2·27	2·57	−0·22	− 233	2094	1·98	1861	1·76	2090	1·98	− 229	−0·22
February	2·14	2·00	1·96	−0·09	− 95	1954	1·85	1859	1·76	2086	1·97	− 227	−0·21
March	2·05	2·10	2·03	+0·37	+ 391	1971	1·86	2362	2·23	1922	1·82	+ 440	+0·42
April	2·42	2·73	2·69	+0·44	+ 465	2121	2·01	2586	2·45	2104	1·99	+ 482	+0·46
May	2·86	2·98	2·84	+0·18	+ 190	2157	2·04	2347	2·22	2036	1·93	+ 311	+0·29
June	3·04	3·11	3·01	+0·14	+ 148	2197	2·08	2345	2·22	2120	2·00	+ 225	+0·21
July	3·18	3·26	3·23	+0·03	+ 32	2251	2·13	2283	2·16	2208	2·09	+ 75	+0·07
August	3·21	3·16	3·12	−0·27	− 286	2225	2·10	1939	1·83	2177	2·06	− 238	−0·23
September	2·94	2·72	2·78	−0·40	− 423	2142	2·03	1719	1·63	2186	2·07	− 467	−0·44
October	2·54	2·35	2·59	−0·16	− 169	2098	1·98	1929	1·82	2131	2·02	− 202	−0·19
November	2·38	2·41	2·44	−0·03	− 32	2064	1·95	2032	1·92	2079	1·97	− 47	−0·04
December	2·35	2·29	2·74	−0·05	− 53	2133	2·02	2080	1·97	1992	1·88	+ 88	+0·08
1889													
January	2·30	2·31	2·56	−0·07	− 74	2091	1·98	2017	1·91	2099	1·99	− 82	−0·08
February	2·23	2·15	2·34	−0·16	− 169	2041	1·93	1872	1·77	1701	1·61	+ 171	+0·16
March	2·07	1·99	1·95	+0·09	+ 95	1952	1·85	2047	1·94	1716	1·62	+ 331	+0·31
April	2·16	2·34	2·33	+0·27	+ 286	2038	1·93	2324	2·20	1792	1·69	+ 532	+0·50
May	2·43	2·52	2·49	+0·31	+ 328	2075	1·96	2403	2·27	1934	1·83	+ 469	+0·44
June	2·74	2·95	2·96	+0·31	+ 328	2186	2·07	2514	2·38	2100	1·99	+ 414	+0·39
July	3·05	3·15	3·00	−0·05	− 53	2196	2·08	2143	2·03	2086	1·97	+ 57	+0·05
August	3·00	2·84	2·91	−0·36	− 381	2174	2·06	1793	1·70	2097	1·98	− 304	−0·29
September	2·64	2·45	2·53	−0·40	− 423	2084	1·97	1661	1·57	2113	2·00	− 452	−0·43
October	2·24	2·03	2·03	−0·34	− 360	1970	1·86	1610	1·52	2020	1·91	− 410	−0·39
November	1·90	1·76	2·03	−0·01	− 11	1970	1·86	1959	1·85	1988	1·88	− 29	−0·03
December	1·89	2·02	2·34	+0·31	+ 328	2041	1·93	2369	2·24	1817	1·72	+ 552	+0·52

a.—Discharge values include a flow of 1,000 c.f.s. through Erie Canal and 1,100 c.f.s. through Welland Canal
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE.	WATER LEVELS OF LAKE ERIE.			STORAGE IN LAKE ERIE.		OUTFLOW THROUGH NIAGARA RIVER. a		TOTAL SUPPLY TO LAKE ERIE.		INFLOW FROM DETROIT RIVER.		LOCAL SUPPLY TO LAKE ERIE.	
	Cleveland, O.		Buffalo, N.Y. of Mean Month.	Foot Depth,	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
	First of Month.	Mean of Month.											
1890													
January	572·20	572·38	572·93	+0·32	+ 338	2178	2·06	2516	2·38	1940	1·83	+ 576	+0·54
February	2·52	2·67	2·74	+0·21	+ 222	2133	2·02	2355	2·23	1797	1·70	+ 558	+0·53
March	2·73	2·79	2·08	+0·31	+ 328	2191	2·07	2519	2·38	1745	1·65	+ 774	+0·73
April	3·04	3·28	3·23	+0·41	+ 434	2251	2·13	2685	2·54	1823	1·72	+ 862	+0·82
May	3·45	3·62	3·59	+0·35	+ 370	2342	2·21	2712	2·56	1839	1·74	+ 873	+0·83
June	3·80	3·99	3·92	0·00	0	2426	2·29	2426	2·29	1964	1·86	+ 462	+0·44
July	3·80	3·61	3·64	−0·42	− 444	2354	2·23	1910	1·81	2046	1·93	− 136	−0·13
August	3·38	3·15	3·17	−0·32	− 338	2237	2·12	1899	1·80	2066	1·95	− 167	−0·16
September	3·06	2·98	2·82	−0·18	− 190	2152	2·04	1962	1·86	1994	1·89	− 32	−0·03
October	2·88	2·79	2·81	−0·10	− 106	2150	2·03	2044	1·93	1919	1·81	+ 125	+0·12
November	2·78	2·76	3·00	−0·14	− 148	2196	2·08	2048	1·94	1950	1·84	+ 98	+0·09
December	2·64	2·53	2·74	−0·22	− 233	2133	2·02	1900	1·80	1875	1·77	+ 25	+0·02
1891													
January	2·42	2·31	2·48	−0·12	− 127	2072	1·96	1945	1·84	1718	1·62	+ 227	+0·22
February	2·30	2·29	2·36	+0·22	+ 233	2046	1·93	2279	2·16	1809	1·71	+ 470	+0·44
March	2·52	2·75	2·50	+0·16	+ 169	2077	1·96	2246	2·12	1534	1·45	+ 712	+0·67
April	2·68	2·62	2·62	−0·15	− 159	2106	1·99	1947	1·84	1830	1·73	+ 117	+0·11
May	2·53	2·44	2·40	−0·02	− 21	2054	1·94	2033	1·92	1865	1·76	+ 168	+0·16
June	2·51	2·58	2·38	+0·02	+ 21	2050	1·94	2071	1·96	1885	1·78	+ 186	+0·18
July	2·53	2·48	2·56	−0·19	− 201	2091	1·98	1890	1·79	1931	1·83	− 41	−0·04
August	2·34	2·21	2·27	−0·22	− 233	2025	1·92	1792	1·69	1952	1·85	− 160	−0·15
September	2·12	2·03	2·10	−0·28	− 296	1986	1·88	1680	1·60	1943	1· 4	− 253	−0·24
October	1·84	1·65	1·73	−0·41	− 434	1903	1·80	1469	1·39	1878	1·78	− 409	−0·39
November	1·43	1·21	1·67	−0·19	− 201	1891	1·79	1690	1·60	1912	1·81	− 222	−0·21
December	1·24	1·28	1·70	+0·06	+ 63	1897	1·79	1960	1·85	1873	1·77	+ 87	+0·08
1892													
January	1·30	1·31	1·61	−0·10	− 106	1878	1·78	1772	1·68	1683	1·59	+ 89	+0·08
February	1·20	1·10	0·92	−0·08	− 85	1733	1·64	1648	1·56	1425	1·35	+ 223	+0·21
March	1·12	1·14	1·12	+0·30	+ 317	1775	1·68	20 2	1·98	1508	1·43	+ 584	+0·55
April	1·42	1·70	1·96	+0·68	+ 719	1954	1·85	2673	2·53	1767	1·67	+ 806	+0·86

May	2·10	2·50	2·40	+0·78	+ 825	2054	1·49	287	2·72	1787	1·69	+1082	+1·03
June	2·88	3·26	3·21	+0·44	+ 465	2246	2·12	2711	2·56	1864	1·76	+ 847	+0·80
July	3·32	3·3	3·42	−0·12	− 127	2299	2·17	2172	2·05	1908	1·80	+ 264	+0·25
August	3·20	3·03	3·05	−0·33	− 349	2208	2·09	185	1·76	1926	1·82	− 67	−0·06
September	2·87	2·71	2·78	−0·44	− 465	2143	2·03	1678	1·59	1981	1·87	− 303	−0·29
October	2·43	2·15	2·45	−0·45	− 476	2066	1·95	1590	1·50	1905	1·80	− 315	−0·30
November	1·98	1·82	2·07	−0·30	− 317	1978	1·87	1661	1·57	1843	1·74	− 182	−0·17
December	1·68	1·55	2·04	−0·32	− 338	1973	1·87	1635	1·55	1753	1·66	− 118	−0·11
1893													
January	1·36	1·17	1·27	−0·15	− 159	1806	1·71	1647	1·56	1464	1·38	+ 183	+0·17
February	1·21	1·25	1·22	+0·15	+ 159	1796	1·70	1955	1·85	1514	1·43	+ 441	+0·42
March	1·36	1·47	1·53	+0·48	+ 508	1861	1·76	2369	2·24	1851	1·75	+ 518	+0·49
April	1·84	2·20	2·19	+0·78	+ 825	2006	1·90	2831	2·68	1883	1·78	+ 948	+0·90
May	2·62	3·04	2·91	+0·52	+ 550	2174	2·06	2724	2·58	1817	1·72	+ 907	+0·86
June	3·14	3·23	3·26	−0·05	− 53	2258	2·14	2205	2·09	1950	1·84	+ 255	+0·24
July	3·09	2·95	3·13	−0·31	− 328	2224	2·10	1896	1·79	2047	1·94	− 151	−0·14
August	2·78	2·61	2·54	−0·36	− 381	2086	1·97	1705	1·61	2052	1·94	− 347	−0·33
September	2·42	2·23	2·29	−0·36	− 381	2028	1·92	1647	1·56	2034	1·92	− 387	−0·37
October	2·06	1·88	2·19	−0·38	− 402	2006	1·90	1604	1·52	1988	1·88	− 384	−0·36
November	1·68	1·48	2·17	−0·16	− 169	2001	1·89	1832	1·73	1990	1·88	− 158	−0·15
December	1·52	1·56	2·13	+0·18	+ 190	1993	1·88	2183	2·06	1958	1·85	+ 225	+0·21
1894													
January	1·70	1·84	2·13	+0·08	+ 85	1993	1·88	2077	1·97	1876	1·77	+ 202	+0·19
February	1·78	1·72	1·75	−0·04	− 42	1908	1·80	1886	1·76	1698	1·61	+ 168	+0·16
March	1·74	1·75	1·86	+0·21	+ 222	1931	1·83	2153	2·04	1877	1·78	+ 276	+0·26
April	1·95	2·15	2·05	+0·39	+ 412	1974	1·87	2386	2·26	1867	1·77	+ 519	+0·49
May	2·34	2·54	2·55	+0·30	+ 317	2088	1·97	2405	2·27	1981	1·87	+ 424	+0·40
June	2·64	2·75	2·94	+0·10	+ 106	2181	2·06	2287	2·16	2045	1·93	+ 242	+0·23
July	2·74	2·73	2·81	−0·20	− 211	2150	2·03	1939	1·83	2048	1·94	− 109	−0·10
August	2·54	2·36	2·34	−0·26	− 275	2040	1·93	1765	1·67	2051	1·94	− 286	−0·27
September	2·28	2·19	2·17	−0·25	− 264	2002	1·89	1738	1·64	2026	1·92	− 288	−0·27
October	2·03	1·87	2·17	−0·28	− 296	2002	1·89	1706	1·61	1971	1·86	− 265	−0·25
November	1·75	1·63	1·99	−0·15	− 159	1962	1·86	1803	1·71	1952	1·85	− 149	−0·14
December	1·60	1·56	1·82	−0·20	− 211	1923	1·82	1712	1·62	1882	1·78	− 170	−0·16
1895													
January	571·40	571·23	571·69	−0·28	− 296	1896	1·79	1600	1·51	b1878	1·78	− 278	−0·26
February	1·12	1·00	1·00	−0·12	− 127	1749	1·65	1622	1·53	b1842	1·74	− 220	−0·21
March	1·00	1·01	0·92	+0·14	+ 148	1733	1·64	1881	1·78	1988	1·88	− 107	−0·10
April	1·14	1·26	1·13	+0·23	+ 243	1777	1·68	2020	1·91	1732	1·64	+ 288	+0·27
May	1·37	1·48	1·48	+0·15	+ 159	1850	1·75	2009	1·90	1814	1·72	+ 195	+0·18
June	1·52	1·57	1·58	0·00	0	1872	1·77	1872	1·77	1861	1·76	+ 11	+0·01
July	1·52	1·46	1·56	−0·10	− 106	1867	1·77	1761	1·67	1898	1·79	− 137	−0·13
August	1·42	1·38	1·42	−0·09	− 95	1838	1·74	1743	1·65	1895	1·79	− 152	−0·14
September	1·33	1·28	1·44	−0·29	− 307	1842	1·74	1535	1·45	1868	1·77	− 333	−0·31
October	1·04	0·80	1·20	−0·29	− 307	1792	1·69	1485	1·40	1794	1·70	− 309	−0·29
November	0·75	0·70	0·71	+0·03	+ 32	1691	1·60	1723	1·63	1722	1·63	+ 1	0·00
December	0·78	0·86	0·97	+0·13	+ 137	1744	1·65	1881	1·78	1748	1·65	+ 133	+0·13

a.—Discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

Date.	WATER LEVELS OF LAKE ERIE.			STORAGE IN LAKE ERIE.		OUTFLOW TDROUGH NIAGARA RIVER. a		SUPPLY TO LAKE RRIE.		INFLOW FROM DETROIT RIVER.		SUPPLY TO LAKE ERIE. LOCAL	
	Cleveland, O. First of Month.	Cleveland, O. Mean of Month.	Buffalo, N.Y. of Mean Month.	Foot Depth,	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1896													
January	0·91	0·96	1·12	+0·01	+ 11	1775	1·68	1786	1·69	1736	1·64	+ 50	+0·05
February	0·92	0·88	1·05	−0·06	− 63	1760	1·66	1697	1·60	1410	1·33	+ 287	+0·27
March	0·86	0·83	0·69	+0·20	+ 211	1687	1·60	1898	1·79	1540	1·46	+ 358	+0·34
April	1·06	1·28	1·22	+0·41	+ 434	1796	1·70	2230	2·11	1681	1·59	+ 549	+0·52
May	1·47	1·66	1·67	+0·33	+ 349	1891	1·79	2240	2·12	1688	1·60	+ 552	+0·52
June	1·80	1·93	1·68	+0·07	+ 74	1893	1·79	1967	1·86	1791	1·69	+ 176	+0·17
July	1·87	1·81	1·86	+0·05	+ 53	1932	1·83	1985	1·88	1888	1·79	+ 97	+0·09
August	1·92	2·02	2·09	−0·06	− 63	1983	1·88	1920	1·82	1898	1·79	+ 22	+0·02
September	1·86	1·70	1·67	−0·28	− 296	1891	1·79	1595	1·51	1837	1·74	− 242	−0·23
October	1·58	1·46	1·41	−0·30	− 317	1836	1·74	1519	1·44	1842	1·74	− 323	−0·31
November	1·28	1·09	1·44	−0·18	− 190	1842	1·74	1652	1·56	1840	1·74	− 188	−0·18
December	1·10	1·12	1·23	0·00	0	1797	1·70	1797	1·70	1683	1·59	+ 114	+0·11
1897													
January	1·10	1·09	1·59	+0·09	+ 95	1875	1·77	1970	1·86	1925	1·82	+ 45	+0·04
February	1·19	1·29	1·15	+0·29	+ 307	1781	1·68	2088	1·97	b1784	1·69	+ 304	+0·29
March	1·48	1·66	1·66	+0·46	+ 486	1888	1·79	2374	2·25	1907	1·80	+ 467	+0·44
April	1·94	2·21	2·18	+0·44	+ 465	2004	1·90	2469	2·33	1849	1·75	+ 620	+0·59
May	2·38	2·54	2·60	+0·21	+ 222	2101	1·99	2323	2·20	1950	1·84	+ 373	+0·35
June	2·59	2·64	2·59	+0·05	+ 53	2097	1·98	2150	2·03	1871	1·77	+ 279	+0·26
July	2·64	2·63	2·57	−0·09	− 95	2093	1·98	1998	1·89	1931	1·83	+ 67	+0·06
August	2·55	2·47	2·45	−0·22	− 233	2066	1·95	1833	1·73	1932	1·83	− 99	−0·09
September	2·33	2·19	2·09	−0·39	− 412	1984	1·88	1572	1·49	1926	1·82	− 354	−0·33
October	1·94	1·70	1·65	−0·30	− 317	1886	1·78	1569	1·48	1898	1·79	− 329	−0·31
November	1·64	1·57	1·69	−0·08	− 85	1895	1·79	1810	1·71	1916	1·81	− 106	−0·10
December	1·56	1·54	1·81	0·00	0	1921	1·82	1921	1·82	1807	1·71	+ 114	+0·11
1898													
January	1·56	1·59	1·68	+0·13	+ 137	1893	1·79	2030	1·92	1756	1·66	+ 274	+0·26
February	1·69	1·79	1·57	+0·23	+ 243	1870	1·77	2113	2·00	1482	1·40	+ 631	+0·60
March	1·92	2·05	1·95	+0·42	+ 444	1951	1·85	2395	2·26	1888	1·79	+ 507	+0·48
April	2·34	2·63	2·55	+0·36	+ 381	2088	1·97	2469	2·33	1848	1·75	+ 621	+0·59

ay	2·70	2·78	2·68	+0·10	+ 106	2119	2·00	2225	2·10	1818	1·72	+ 407	+0·38
June	2·80	2·81	2·72	−0·10	− 106	2128	2·01	2022	1·91	1893	1·79	+ 129	+0·12
July	2·70	2·59	2·50	−0·21	− 222	2077	1·96	1855	1·75	1986	1·88	− 131	−0·12
August	2·49	2·39	2·46	−0·29	− 307	2068	1·96	1761	1·67	1931	1·83	− 170	−0·16
September	2·20	2·01	2·08	−0·29	− 307	1981	1·87	1674	1·58	1964	1·86	− 290	−0·27
October	1·91	1·81	1·91	−0·16	− 169	1943	1·84	1774	1·68	1896	1·79	− 122	−0·12
November	1·75	1·69	2·01	−0·15	− 159	1965	1·86	1806	1·71	1969	1·86	− 163	−0·15
December	1·60	1·52	2·07	0·00	0	1978	1·87	1978	1·87	1996	1·89	− 18	−0·02
1899													
January	1·60	1·67	2·05	−0·04	− 42	1974	1·87	1932	1·83	1947	1·84	− 15	−0·01
February	1·56	1·46	1·59	+0·08	+ 85	1875	1·77	1960	1·85	*b*1856	1·76	+ 104	+0·10
March	1·64	1·83	1·85	+0·34	+ 360	1929	1·82	2289	2·16	1366	1·29	+ 923	+0·87
April	1·98	2·13	2·04	+0·30	+ 317	1973	1·87	2290	2·17	1655	1·57	+ 635	+0·60
May	2·28	2·44	2·32	+0·22	+ 233	2036	1·93	2269	2·15	1812	1·71	+ 457	+0·43
June	2·50	2·56	2·51	−0·08	− 85	2079	1·97	1994	1·89	1935	1·83	+ 59	+0·06
July	2·42	2·28	2·45	−0·24	− 254	2066	1·95	1812	1·71	2022	1·91	− 210	−0·20
August	2·18	2·09	2·09	−0·21	− 222	1983	1·88	1761	1·67	2031	1·92	− 270	−0·26
September	1·97	1·85	1·90	−0·24	− 254	1941	1·84	1687	1·60	2015	1·91	− 328	−0·31
October	1·73	1·61	1·48	−0·11	− 116	1850	1·75	1734	1·64	1923	1·82	− 189	−0·18
November	1·62	1·62	1·55	−0·14	− 148	1866	1·76	1718	1·62	1883	1·78	− 165	−0·16
December	1·48	1·34	1·96	−0·13	− 137	1954	1·85	1817	1·72	1822	1·72	− 5	0·00
1900													
January	571·35	571·36	571·67	+0·11	+ 116	1891	1·79	2007	1,90	1736	1·64	+ 271	+0·26
February	1·46	1·57	1·61	+0·28	+ 296	1878	1·78	2174	2·06	1778	1·68	+ 396	+0·37
March	1·74	1·92	1·82	+0·34	+ 360	1923	1·82	2283	2·16	1874	1·77	+ 409	+0·39
April	2·08	2·23	2·16	+0·23	+ 243	1999	1·89	2242	2·12	1780	1·68	+ 462	+0·44
May	2·31	2·39	2·33	+0·12	+ 127	2038	1·93	2165	2·05	1796	1·70	+ 369	+0·35
June	2·43	2·47	2·41	−0·03	− 32	2056	1·94	2024	1·91	1868	1·77	+ 156	+0·15
July	2·40	2·34	2·43	−0·08	− 85	2061	1·95	1976	1·87	1932	1·83	+ 44	+0·04
August	2·32	2·31	2·31	−0·17	− 180	2034	1·92	1854	1·75	1957	1·85	− 103	−0·10
September	2·15	1·99	2·07	−0·28	− 296	1978	1·87	1682	1·59	1978	1·87	− 296	−0·28
October	1·87	1·75	1·68	−0·25	− 264	1893	1·79	1629	1·54	1953	1·85	− 324	−0·31
November	1·62	1·49	1·84	−0·15	− 159	1927	1·82	1768	1·67	1974	1·87	− 206	−0·19
December	1·47	1·45	1·77	−0·07	− 74	1912	1·81	1838	1·74	1911	1·81	− 73	−0·07
1901													
January	1·40	1·35	1·60	−0·22	− 233	1876	1·77	1643	1·55	1719	1·63	− 76	−0·07
February	1·18	1·00	1·03	−0·24	− 254	1755	1·66	1501	1·42	1410	1·33	+ 91	+0·09
March	0·94	0·88	0·82	+0·14	+ 148	1712	1·62	1860	1·76	1548	1·46	+ 312	+0·30
April	1·08	1·29	1·05	+0·22	+ 233	1760	1·66	1993	1·88	1161	1·10	+ 832	+0·79
May	1·30	1·31	1·17	+0·22	+ 233	1786	1·69	2019	1·91	1706	1·61	+ 313	+0·30
June	1·52	1·72	1·69	+0·30	+ 317	1896	1·79	2213	2·09	1986	1·88	+ 227	+0·21
July	1·82	1·91	1·88	+0·02	+ 21	1936	1·83	1957	1·85	2025	1·94	− 95	−0·09
August	1·84	1·78	1·70	−0·10	− 106	1897	1·79	1791	1·69	2084	1·97	− 293	−0·28
September	1·74	1·71	1·75	−0·22	− 233	1908	1·80	1675	1·58	2052	1·92	− 350	−0·33
October	1·52	1·33	1·53	−0·28	− 296	1861	1·76	1565	1·48	1983	1·88	− 418	−0·40
November	1·24	1·16	1·39	−0·06	− 63	1831	1·73	1768	1·67	1963	1·86	− 195	−0·18
December	1·18	1·19	1·37	−0·04	− 42	1827	1·73	1785	1·69	1935	1·83	− 150	−0·14

a.—Discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 26.—Continued.

SUPPLY FACTORS OF LAKE ERIE.

DATE.	WATER LEVELS OF LAKE ERIE.			STORAGE IN LAKE ERIE.		OUTFLOW THROUGH NIAGARA RIVER. *a*		TOTAL SUPPLY TO LAKE ERIE.		INFLOW FROM DETROIT RIVER.		LOCAL SUPPLY TO LAKE ERIE.	
	Cleveland, O.		Buffalo, N.Y.										
	First of Month.	Mean of Month.	Mean of Month.	Foot Depth,	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Erie.	100 c.f.s.	Foot Depth.
1902													
January	1·14	1·08	1·41	−0·28	− 296	1836	1·74	1540	1·46	1522	1·44	+ 18	+0·02
February	0·86	0·63	0·79	−0·08	− 85	1706	1·61	1621	1·53	1464	1·38	+ 157	+0·15
March	0·78	0·94	0·95	+0·44	+ 465	1739	1·64	2204	2·08	1827	1·73	+ 377	+0·36
April	1·22	1·49	1·50	+0·46	+ 486	1855	1·75	2341	2·21	1816	1·72	+ 525	+0·50
May	1·68	1·86	1·74	+0·31	+ 328	1906	1·80	2234	2·11	1818	1·72	+ 416	+0·39
June	1·99	2·12	2·05	+0·44	+ 465	1975	1·87	2440	2·31	1936	1·83	+ 504	+0·48
July	2·43	2·74	2·73	+0·30	+ 317	2130	2·01	2447	2·31	2054	1·94	+ 393	+0·37
August	2·73	2·72	2·64	−0·18	− 190	2110	2·00	1920	1·82	2003	1·89	− 83	−0·08
September	2·55	2·38	2·30	−0·21	− 222	2031	1·92	1809	1·71	1944	1·84	− 135	−0·13
October	2·34	2·29	2·39	−0·18	− 190	2053	1·94	1863	1·76	1905	1·80	− 42	−0·04
November	2·16	2·02	2·14	−0·24	− 254	1995	1·89	1741	1·05	1846	1·75	− 105	−0·10
December	1·92	1·82	2·20	−0·15	− 159	2009	1·90	1850	1·75	1919	1·81	− 69	−0·07
1903													
January	1·77	1·72	1·99	−0·06	− 63	1961	1·85	1898	1·79	1988	1·88	− 90	−0·09
February	1·71	1·70	1·70	+0·28	+ 296	1897	1·79	2193	2·07	1851	1·75	+ 342	+0·32
March	1·99	2·28	2·13	+0·67	+ 708	1992	1·88	2700	2·55	1837	1·74	+ 863	+0·82
April	2·66	3·05	2·83	+0·41	+ 434	2154	2·04	2588	2·45	1879	1·78	+ 709	+0·67
May	3·07	3·09	2·85	0·00	0	2159	2·04	2159	2·04	1803	1·71	+ 356	+0·34
June	3·07	3·05	2·95	−0·05	− 53	2184	2·07	2131	2·02	1911	1·81	+ 220	+0·21
July	3·02	2·98	2·99	−0·15	− 159	2194	2·07	2035	1·92	1958	1·85	+ 77	+0·07
August	2·87	2·76	2·64	−0·19	− 201	2110	2·00	1909	1·81	1978	1·87	− 69	−0·07
September	2·68	2·59	2·55	−0·26	− 275	2088	1·97	1813	1·71	1997	1·89	− 184	−0·17
October	2·42	2·25	2·36	−0·41	− 434	2045	1·93	1611	1·52	1999	1·89	− 388	−0·37
November	2·01	1·77	2·01	−0·47	− 497	1966	1·86	1469	1·39	1910	1·81	− 441	−0·42
December	1·54	1·31	2·02	−0·29	− 307	1968	1·86	1661	1·57	2138	2·02	− 477	−0·45
1904													
January	1·25	1·19	1·06	−0·01	− 11	1762	1·67	1751	1·66	1612	1·52	+ 139	+0·13
February	1·24	1·28	1·30	+0·33	+ 349	1813	1·71	2162	2·04	1682	1·59	+ 480	+0·45
March	1·57	1·86	1·86	+0·81	+ 857	1931	1·83	2788	2·64	*b*1825	1·73	+ 903	+0·91
April	2·38	2·91	2·89	+0·66	+ 698	2170	2·05	2868	2·71	2035	1·92	+ 833	+0·79

May	3·04	3·17	3·23	+0·20	+ 211	2252	2·13	2463	2·33	1902	1·80	+ 561	+0·53
June	3·24	3·32	3·49	+0·12	+ 127	2317	2·19	2444	2·31	2031	1·92	+ 413	+0·39
July	3·36	3·41	3·41	−0·10	− 106	2296	2·17	2190	2·07	2083	1·97	+ 107	+0·10
August	3·26	3·10	3·12	−0·29	− 307	2225	2·10	1918	1·81	2103	1·99	− 185	−0·17
September	2·97	2·84	2·84	−0·31	− 328	2157	2·04	1829	1·73	2079	1·97	− 250	−0·24
October	2·66	2·49	2·61	−0·36	− 381	2103	1·99	1722	1·63	2035	1·92	− 313	−0·30
November	2·30	2·12	2·31	−0·36	− 381	2033	1·92	1652	1·56	1992	1·88	− 340	−0·32
December	1·94	1·77	2·13	−0·30	− 317	1993	1·88	1676	1·58	2019	1·91	− 343	−0·32
1905													
January	571·64	571·52	571·74	−0·22	− 233	1906	1·80	1673	1·58	1580	1·49	+ 93	+0·09
February	1·42	1·31	1·23	−0·18	− 190	1797	1·70	1607	1·52	1534	1·45	+ 73	+0·07
March	1·24	1·18	1·32	+0·26	+ 275	1816	1·72	2091	1·98	1676	1·58	+ 415	+0·39
April	1·50	1·83	1·79	+0·64	+ 677	1917	1·81	2594	2·45	1947	1·84	+ 647	+0·61
May	2·14	2·46	2·38	+0·58	+ 613	2049	1·94	2662	2·52	1922	1·82	+ 740	+0·70
June	2·72	2·98	2·97	+0·30	+ 317	2188	2·07	2505	2·37	2066	1·95	+ 439	+0·42
July	3·02	3·06	3·28	−0·06	− 63	2264	2·14	2201	2·08	2118	2·00	+ 83	+0·08
August	2·96	2·87	3·06	−0·21	− 222	2209	2·09	1987	1·88	2124	2·01	− 137	−0·13
September	2·75	2·63	2·86	−0·28	− 296	2161	2·04	1865	1·76	2094	1·98	− 229	−0·22
October	2·47	2·31	2·65	−0·35	− 370	2112	2·00	1742	1·65	2052	1·94	− 310	−0·29
November	2·12	1·93	2·29	−0·20	− 211	2029	1·92	1818	1·72	2004	1·90	− 186	−0·18
December	1·92	1·92	2·45	+0·01	+ 11	2066	1·95	2077	1·96	1942	1·85	+ 135	+0·13
1906													
January	1·93	1·94	2·33	+0·01	+ 11	2038	1·93	2049	1·94	1991	1·88	+ 58	+0·05
February	1·94	1·93	1·88	−0·12	− 127	1936	1·83	1809	1·71	1548	1·46	+ 261	+0·25
March	1·82	1·71	1·66	+0·10	+ 106	1889	1·79	1995	1·89	1600	1·51	+ 395	+0·37
April	1·92	2·13	2·06	+0·34	+ 360	1977	1·87	2337	2·21	1905	1·80	+ 432	+0·41
May	2·26	2·40	2·27	+0·24	+ 254	2025	1·92	2279	2·16	1993	1·88	+ 286	+0·27
June	2·50	2·60	2·49	+0·12	+ 127	2075	1·96	2202	2·08	2034	1·92	+ 168	+0·16
July	2·62	2·64	2·56	+0·02	+ 21	2091	1·98	2112	2·00	2089	1·98	+ 23	+0·02
August	2·64	2·63	2·51	−0·15	− 159	2078	1·97	1919	1·81	2082	1·97	− 163	−0·15
September	2·49	2·35	2·27	+0·21	− 222	2025	1·92	1803	1·71	2039	1·93	− 236	−0·22
October	2·28	2·21	2·25	−0·08	− 85	2020	1·91	1935	1·83	2021	1·91	− 86	−0·08
November	2·20	2·18	2·32	+0·10	+ 106	2036	1·93	2142	2·03	1994	1·89	+ 148	+0·14
December	2·30	2·42	2·45	+0·29	+ 307	2066	1·95	2373	2·24	1895	1·79	+ 478	+0·45
1907													
January	2·59	2·76	2·96	+0·02	+ 21	2185	2·07	2206	2·09	1779	1·68	+ 427	+0·40
February	2·61	2·46	2·47	−0·26	− 275	2070	1·96	1795	1·70	1711	1·62	+ 84	+0·08
March	2·35	2·24	2·22	+0·13	+ 137	2014	1·90	2151	2·03	1749	1·65	+ 402	+0·38
April	2·48	2·71	2·62	+0·30	+ 317	2105	1·99	2422	2·29	1931	1·83	+ 491	+0·46
May	2·78	2·85	2·84	+0·28	+ 296	2157	2·04	2453	2·32	1962	1·86	+ 491	+0·46
June	3·06	3·27	3·18	+0·23	+ 243	2239	2·12	2482	2·35	1990	1·88	+ 492	+0·47
July	3·29	3·31	3·33	−0·12	− 127	2276	2·15	2149	2·03	2075	1·96	+ 74	+0·07
August	3·17	3·03	3·02	−0·27	− 286	2200	2·08	1914	1·81	2028	1·92	− 114	−0·11
September	2·90	2·77	2·80	−0·17	− 180	2148	2·03	1968	1·86	2047	1·94	− 79	−0·07
October	2·73	2·69	2·79	−0·18	− 190	2145	2·03	1955	1·85	2017	1·91	− 62	−0·06
November	2·55	2·41	2·71	−0·21	− 222	2126	2·01	1904	1·80	1961	1·85	− 57	−0·05
December	2·34	2·26	2·63			2108	1·99			1952	1·85		

a.—Discharge values include a flow of 1000 c.f. s. through Erie Canal and 1000 c. f. s. through Welland Canal.
b.—St. Clair River discharge used.

TABLE 27.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of—				Storage in Lake Ontario.		Outflow through St. Lawrence River		Total Supply to Lake Ontario.		Inflow from Niagara River. *a*		Local Supply to Lake Ontario.	
	Lake Ontario		St. Lawrence River.											
	Oswego, N.Y.													
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, mean of Month.	Foot Mean of	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1860														
January	....	246·58	245·65	244·08	....	....	2629	3·42	....	....	2321	3·02	....	....
February	246·65	6·72	5·78	4·22	+0·09	+ 69	2661	3·46	2730	3·55	2178	2·83	552	0·72
March	6·74	6·77	5·83	4·26	+0·04	+ 31	2689	3·50	2720	3·54	2265	2·95	455	0·59
April	6·78	6·80	5·86	4·29	+0·14	+108	2699	3·51	2807	3·65	2423	3·15	384	0·50
May	6·92	7·03	6·07	4·80	+0·38	+292	2883	3·75	3175	4·13	2475	3·22	700	0·91
June	7·30	7·57	6·58	5·31	+0·40	+307	3062	3·99	3369	4·39	2486	3·24	883	1·15
July	7·70	7·82	6·82	5·55	−0·16	−123	3146	4·09	3023	3·93	2436	3·17	587	0·76
August	7·54	7·26	6·29	5·02	−0·48	−369	2960	3·85	2591	3·37	2375	3·09	216	0·28
September	7·06	6·86	5·91	4·64	−0·30	−231	2827	3·68	2596	3·38	2304	3·00	292	0·38
October	6·76	6·67	5·73	4·46	−0·05	− 38	2767	3·60	2729	3·55	2244	2·92	485	0·63
November	6·71	6·75	5·81	4·54	+0·03	+ 23	2794	3·64	2817	3·67	2248	2·93	569	0·74
December	6·74	6·63	5·79	4·22	−0·16	−123	2676	3·48	2553	3·32	2256	2·94	297	0·38
1861														
January	6·58	6·44	5·52	3·95	−0·08	− 62	2587	3·37	2525	3·29	2161	2·81	364	0·48
February	6·50	6·56	6·63	4·07	+0·28	+215	2615	3·40	2830	3·68	2045	2·66	785	1·02
March	6·78	7·01	6·05	4·49	+0·34	+261	2754	3·58	3015	3·92	2136	2·78	879	1·14
April	7·12	7·23	6·26	4·70	+0·58	+446	2826	3·68	3272	4·26	2375	3·09	897	1·17
May	7·70	8·18	7·16	5·89	+0·66	+507	3267	4·25	3774	4·91	2485	3·23	1289	1·68
June	8·36	8·54	7·50	6·23	+0·07	+ 54	3390	4·41	3444	4·48	2521	3·28	923	1·20
July	8·43	8·32	7·29	6·02	−0·23	−177	3313	4·31	3136	4·08	2474	3·22	662	0·86
August	8·20	8·07	7·05	5·79	−0·36	−277	3215	4·18	2938	3·82	2463	3·21	475	0·61
September	7·84	7·60	6·61	5·34	−0·14	−108	3072	4·00	2964	3·86	2431	3·16	533	0·70
October	7·70	7·81	6·81	5·54	+0·12	+ 92	3141	4·09	3233	4·21	2387	3·11	846	1·10
November	7·82	7·82	6·82	5·55	−0·10	− 77	3147	4·10	3070	4·00	2410	3·14	660	0·86
December	7·72	7·61	6·62	5·06	−0·36	−277	2949	3·84	2672	3·48	2401	3·12	271	0·36
1862														
January	7·36	7·11	6·15	4·59	−0·46	−353	2789	3·63	2436	3·17	2365	3·08	71	0·09
February	6·90	6·69	5·75	4·19	+0·04	+ 31	2656	3·46	2687	3·50	2237	2·91	450	0·59
March	6·94	7·18	6·21	4·65	+0·69	+530	2808	3·65	3338	4·34	2258	2·94	1080	0·40
April	7·63	8·08	7·06	5·50	+0·85	−653	3103	4·04	3756	4·89	2471	3·22	1285	1·67

May.........	8·48	8·88	7·82	6·55	+0·27	+208	3512	4·57	3720	4·84	2531	3·29	1189	1·55
June.........	8·75	8·62	7·57	6·31	−0·08	− 62	3404	4·43	3342	4·35	2551	3·32	791	1·03
July.........	8·67	8·72	7·67	6·40	−0·18	−138	3454	4·50	3316	4·32	2562	3·33	754	0·99
August......	8·49	8·26	7·23	5·97	−0·55	−423	3280	4·27	2857	3·72	2439	3·17	418	0·55
September..	7·94	7·61	6·62	5·35	−0·60	−461	3075	4·00	2614	3·40	2375	3·09	239	0·31
October.....	7·34	7·08	6·12	4·85	−0·44	−338	2900	3·77	2562	3·33	2294	2·99	268	0·34
November..	6·90	6·73	5·79	4·52	−0·22	−169	2788	3·63	1619	3·41	2237	2·91	382	0·50
December...	6·68	6·62	5·69	4·12	+0·02	+ 15	2642	3·44	2657	3·46	2291	2·98	366	0·48
1863														
January.....	6·70	6·77	5·83	4·26	+0·10	+ 77	2689	3·50	2766	3·60	2372	3·09	394	0·51
February....	6·80	6·83	5·88	4·32	+0·07	+ 54	2698	3·51	2752	3·58	2390	3·11	362	0·47
March.......	6·87	6·91	5·96	4·40	+0·40	+307	2725	3·55	3032	3·95	2361	3·07	671	0·88
April.. . . .	7·27	7·63	6·64	5·08	+0·56	+430	2956	3·85	3386	4·41	2375	3·09	1011	1·32
May... . . .	7·83	8·03	7·02	5·75	+0·27	+208	3218	4·19	3426	4·46	2418	3·15	1008	1·31
June... . . .	8·10	8·18	7·16	5·89	−0·12	− 92	3267	4·25	3175	4·13	2400	3·12	775	1·01
July...	7·98	7·77	6·77	5·50	−0·44	−338	3128	4·07	2790	3·63	2387	3·11	403	0·52
August..	7·54	7·31	6·34	5·07	−0·42	−323	2977	3·87	2654	3·45	2346	3·05	308	0·40
September	7·12	6·93	5·98	4·71	−0·28	−215	2850	3·71	2635	3·43	2264	2·95	371	0·48
October.....	6·84	6·74	5·80	4·53	−0·19	−146	2790	3·63	2644	3·44	2172	2·83	472	0·61
November—	6·65	6·56	5·63	4·36	−0·09	+ 69	2732	3·56	2663	3·47	2101	2·73	562	0·74
December...	6·56	6·57	5·64	4·08	−0·11	− 84	2619	3·41	2535	3·30	2137	2·78	398	0·52
1864														
January.....	6·45	6·33	5·41	3·85	−0·20	−154	2544	3·31	2390	3·11	2041	2·66	348	0·45
February....	6·25	6·17	5·26	3·70	−0·03	− 23	2496	3·25	2473	3·22	2025	2·64	448	0·58
March.......	6·22	6·26	5·35	3·78	+0·32	+246	2532	3·30	2778	3·62	2061	2·68	717	0·94
April........	6·54	6·83	5·88	4·32	+0·78	+399	2698	3·51	3297	4·29	2157	2·81	1140	0·48
May..........	7·32	7·82	6·82	5·55	+0·65	+499	3146	4·09	3645	4·74	2332	3·04	1313	1·70
June..........	7·97	8·12	7·10	5·83	−0·01	− 8	3246	4·22	3238	4·21	2337	3·04	901	1·17
July..........	7·96	7·80	6·80	5·53	−0·39	−300	3140	4·09	2840	3·70	2288	2·98	552	0·72
Aug..........	7·57	7·34	6·37	5·10	−0·49	−376	2989	3·89	2613	3·40	2203	2·87	410	0·53
September..	7·08	6·81	5·87	4·60	−0·38	−292	2814	3·66	2522	3·28	2165	2·82	357	0·46
October.....	6·70	6·58	5·65	4·38	−0·14	−108	2740	3·57	2632	3·43	2105	2·74	527	0·69
November..	6·56	6·55	5·62	4·35	+0·04	+ 31	2730	3·55	2761	3·59	2091	2·72	670	0·87
December...	6·60	6·65	5·72	4·15	+0·26	+200	2652	3·45	2852	3·71	2153	2·80	699	0·91
1865														
January.....	246·86	247·08	246·12	244·56	+0·30	+230	2778	3·62	3008	3·92	2022	2·63	986	1·29
February....	7·16	7·23	6·26	4·70	+0·14	+108	2826	3·68	2934	3·82	1846	2·40	1088	1·42
March.......	7·30	7·38	6·40	4·84	+0·12	+ 92	2873	3·74	2965	3·86	1904	2·48	1061	1·38
April........	7·42	7·46	6·48	4·92	+0·12	+ 92	2900	3·77	2992	3·89	2050	2·67	942	1·22
May..........	7·54	7·62	6·63	4·36	+0·10	+ 77	3079	4·01	3156	4·11	2183	2·84	973	1·27
June..........	7·64	7·66	6·67	5·40	−0·06	− 46	3093	4·03	3047	3·97	2195	2·86	852	1·11
July..........	7·58	7·51	6·53	5·36	−0·38	−292	3040	3,96	2748	3·58	2203	2·87	545	0·71
August......	7·20	6·90	5·95	4·68	−0·60	−461	2842	3·70	2381	3·10	2165	2·82	216	0·28
September..	6·60	6·29	5·38	4·10	−0·42	−323	2659	3·46	2336	3·04	2171	2·83	165	0·21
October.....	6·18	6·07	5·17	3·90	−0·24	−184	2584	3·36	2400	3·12	2112	2·75	288	0·37
November..	5·94	5·82	4·93	3·66	−0·20	−154	2501	3·26	2347	3·06	2050	2·67	297	0·39
December...	5·74	5·66	4·78	3·21	−0·18	−138	2350	3·06	2212	2·88	2061	2·68	151	0·20

a.—Niagara River discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of—				Storage in Lake Ontario.		Outflow through St. Lawrence River		Total Supply to Lake Ontario.		Inflow from Niagara River. *a*		Local Supply to Lake Ontario.	
	Lake Ontario		St. Lawrence River.											
	Oswego, N.Y.													
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, Mean of Month.	Foot Depth	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1866														
January.....	5·56	5·46	4·59	3·03	−0·10	−077	2286	2·98	2209	2·88	1971	2·57	238	0·31
February....	5·46	5·47	4·60	3·04	+0·02	+ 15	2288	2·98	2303	3·00	1887	2·46	416	0·54
March.......	5·48	5·48	4·61	3·04	+0·24	+184	2297	2·99	2481	3·23	1962	2·55	519	0·68
April........	5·72	5·96	5·06	3·50	+0·27	+208	2432	3·17	2640	3·44	2077	2·70	563	0·74
May.........	5·99	6·02	5·12	3·85	−0·02	− 15	2565	3·34	2550	3·32	2125	2·77	425	0·55
June.........	5·97	5·92	5·03	3·75	+0·41	+315	2543	3·31	2858	3·72	2206	2·87	652	0·85
July.........	6·38	6·84	5·89	4·62	+0·41	+315	2822	3·67	3137	4·08	2248	2·93	889	1·15
August......	6·78	6·74	5·80	4·53	−0·09	− 69	2791	3·63	2722	3·54	2169	2·82	553	0·72
September..	6·70	6·65	5·72	4·44	−0·12	− 92	2772	3·61	2680	3·49	2169	2·83	511	0·66
October.....	6·58	6·52	5·59	4·32	−0·18	−138	2720	3·54	2582	3·36	2181	2·84	401	0·52
November..	6·40	6·28	5·37	4·09	−0·16	−123	2655	3·46	2532	3·30	2150	2·80	382	0·50
December...	6·24	6·20	5·29	3·73	−0·16	−123	2505	3·26	2382	3·10	2197	2·86	185	0·24
1867														
January.....	6·08	5·95	5·06	3·49	−0·14	−108	2438	3·17	2330	3·03	2098	2·73	232	0·30
February....	5·94	5·92	5·03	3·46	+0·33	+254	2428	3·16	2682	3·49	1975	2·57	707	0·92
March.......	6·27	6·26	5·69	4·12	+0·80	+615	2642	3·44	3257	4·24	2055	2·67	1202	1·57
April........	7·07	7·52	6·54	4·97	+0·79	+607	2929	3·81	3536	4·60	2112	2·75	1424	1·85
May.........	7·86	8·21	7·19	5·92	+0·48	+369	3278	4·27	3647	4·75	2234	2·91	1413	1·84
June.........	8·34	8·48	7·44	6·17	−0·04	− 31	3370	4·39	3339	4·35	2330	3·03	1009	1·32
July.........	8·30	8·11	7·09	5·82	−0·50	−384	3243	4·22	2859	3·72	2298	2·99	561	0·73
August......	7·80	7·48	6·50	5·23	−0·57	−438	3030	3·94	2592	3·37	2203	2·87	389	0·50
September..	7·23	6·98	6·03	4·76	−0·57	−438	2866	3·73	2428	3·16	2123	2·76	305	0·40
October.....	6·66	6·33	5·41	4·14	−0·70	−538	2659	3·46	2121	2·76	2058	2·68	63	0·08
November..	5·96	5·59	4·72	3·44	−0·75	−576	2445	3·18	1869	2·43	1970	2·56	− 101	−0·13
December...	5·21	4·83	4·00	2·43	−0·54	−415	2111	2·75	1696	2·21	1964	2·56	− 268	−0·35
1868														
January.....	4·67	4·51	3·70	2·93	−0·11	− 84	1699	2·21	1615	2·10	1891	2·46	− 276	−0·36
February....	4·56	4·61	3·79	2·22	+0·18	+138	2049	2·67	2187	2·85	1765	2·30	422	0·55
March.......	4·74	4·88	4·05	2·48	+0·46	+353	2126	2·77	2479	3·23	1878	2·44	601	0·79
April........	5·20	5·52	4·65	3·08	+0·62	+476	2309	3·01	2785	3·63	2048	2·67	737	0·96

May.........	5·82	6·12	5·22	3·94	+0·51	+392	2605	3·39	2997	3·90	2149	2·80	848	1·10
June.........	6·33	6·54	5·61	4·34	+0·15	+115	2725	3·55	2840	3·70	2261	2·94	579	0·76
July.........	6·48	6·42	5·50	4·22	−0·20	−154	2699	3·51	2545	3·31	2270	2·95	275	0·36
August......	6·28	6·13	5·23	3·95	−0·24	−184	2609	3·40	2425	3·16	2125	2·77	300	0·39
September..	6·04	5·94	5·05	3·77	−0·40	−307	2552	3·32	2245	2·92	2077	2·70	168	0·22
October.....	5·64	5·35	4·49	3·21	−0·36	−277	2370	3·08	2093	2·72	1987	2·59	106	0·13
November..	5·28	5·20	4·35	3·07	0·00	0	2326	3·03	2326	3·03	1976	2·57	350	0·46
December...	5·28	5·37	4·51	2·94	+0·02	+ 15	2266	2·95	2281	2·97	1973	2·57	308	0·40
1869														
January.....	5·30	5·22	4·37	2·80	−0·02	− 15	2223	2·89	2209	2·87	1941	2·53	267	0·34
February....	5·28	5·34	4·48	2·91	+0·17	+131	2257	2·94	2388	3·11	1878	2·44	510	0·67
March.......	5·45	5·56	4·69	3·12	+0·37	+284	2322	3·02	2606	3·39	1973	2·57	633	0·82
April........	5·82	6·09	5·19	3·62	+0·60	+461	2480	3·23	2941	3·83	2025	2·64	916	1·19
May.........	6·42	6·75	5·81	4·54	+0·44	+388	2794	3·64	3132	4·08	2149	2·80	983	1·28
June.........	6·86	6·97	6·18	4·75	+0·27	+208	3076	4·00	3284	4·27	2261	2·94	1023	1·33
July.........	7·13	7·29	6·41	5·05	+0·19	+146	3091	4·02	3237	4·21	2348	3·06	889	1·15
August......	7·32	7·35	6·41	5·11	−0·06	− 46	3029	3·94	2983	3·88	2304	3·00	679	0·88
September..	7·26	7·17	6·16	4·94	−0·14	−108	2862	3·72	2754	3·58	2251	2·93	503	0·65
October.....	7·12	7·08	6·08	4·85	−0·24	−184	2845	3·70	2661	3·46	2157	2·81	504	0·65
November..	6·88	6·68	5·70	4·47	−0·12	− 92	2717	3·54	2625	2·42	2075	2·70	550	0·72
December...	6·76	6·85	6·04	4·34	+0·30	+230	2852	3·71	3082	4·01	2203	2·87	879	1·14
1870														
January.....	247·06	247·26	246·32	244·73	+0·28	+215	2748	3·58	2963	3·86	2229	2·90	734	0·99
February....	7·34	7·41	6·36	4·87	+0·07	+ 54	[21]2040	2·66	2094	2·73	2231	2·90	−137	−0·18
March.......	7·41	7·41	6·16	4·87	+0·47	+361	[21]2760	3·59	3121	4·06	2164	2·82	957	1·25
April........	7·88	8·35	7·35	5·76	+0·77	+592	3232	4·21	3824	4·98	2306	3·00	1518	1·98
May.........	8·65	8·95	7·87	6·62	+0·14	+108	3505	4·56	3613	4·70	2356	3·07	1257	1·63
June.........	8·79	8·63	7·60	6·32	−0·32	−246	3441	4·48	3195	4·16	2368	3·08	827	1·08
July.........	8·47	8·31	7·36	6·01	−0·33	−254	3432	4·47	3178	4·14	2395	3·12	783	1·02
August......	8·14	7·97	7·03	6·69	−0·52	−400	3298	4·29	2898	3·77	2361	3·07	537	0·70
September...	7·62	7·28	6·19	5·04	−0·50	−384	2795	3·64	2411	3·14	2314	3·01	97	0·13
October.....	7·12	6·95	5·87	4·73	−0·46	−353	2681	3·49	2328	3·03	2234	2·91	94	0·12
November..	6·66	6·38	5·64	4·19	−0·40	−307	2898	3·77	2591	3·37	2188	2·85	403	0·52
December...	6·26	6·13	5·23	3·66	−0·16	−123	2493	3·24	2370	3·08	2206	2·87	164	0·21
1871														
January.....	6·10	6·06	5·16	3·59	−0·12	−92	2471	3·22	2379	3·10	2123	2·76	256	0·34
February....	5·98	5·98	5·00	3·43	+0·02	+ 15	2419	3·15	2434	3·17	1997	2·60	437	0·57
March.......	6·00	6·10	5·20	3·63	+0·40	+307	2483	3·23	2790	3·63	2088	2·72	702	0·91
April........	6·40	6·70	5·76	4·20	+0·51	+392	2658	3·46	3050	3·97	2185	2·84	865	1·13
May.........	6·91	7·12	6·02	4·89	+0·18	+138	2722	3·54	2860	3·72	2248	2·93	612	0·80
June.........	7·09	7·06	6·28	4·83	−0·11	− 84	3131	4·08	3047	3·97	2273	2·96	774	1·01
July.........	6·98	6·90	6·01	4·68	−0·30	−230	2921	3·80	2691	3·50	2285	2·97	406	0·53
August......	6·68	6·46	5·66	4·26	−0·39	−300	2857	3·72	2557	3·33	2215	2·88	342	0·45
September...	6·29	6·12	5·34	3·94	−0·42	−323	2749	3·58	2426	3·16	2188	2·85	238	0·31
October.....	5·87	5·62	4·99	3·47	−0·45	−346	2722	3·54	2376	3·09	2045	2·66	331	0·43
November..	5·42	5·21	2·39	3·08	−0·36	−277	2361	3·07	2084	2·71	2029	2·64	55	0·07
December...	5·06	4·90	4·07	2·50	−0·24	−184	2132	2·77	1948	2·53	1973	2·57	− 25	−0·04

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived fron gauge observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.*	Water Levels of—				Storage in Lake Ontario.		Outflow through St. Lawrence River.		Total Supply to Lake Ontario.		Inflow from Niagara River.		Local Supply to Lake Ontario.	
	Lake Ontario. Oswego, N.Y.		St. Lawrence River.											
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1872														
January	4·82	4·73	3·91	2·34	−0·20	−154	[212]2062	2·68	1908	2·48	1925	2·51	− 17	−0·02
February	4·62	4·51	3·70	2·13	−0·19	−146	[211]1873	2·44	1727	2·25	1828	2·38	−101	−0·13
March	4·43	5·35	3·55	1·98	+0·17	+131	[211]1945	2·53	2076	2·70	1798	2·34	278	0·36
April	4·60	4·84	4·01	2·44	+0·30	+230	2114	2·75	2344	3·05	1825	2·38	519	0·67
May	4·90	4·96	4·31	2·85	+0·22	+169	2448	3·19	2617	3·41	1917	2·50	700	0·91
June	5·12	5·29	4·53	3·16	+0·20	+154	2453	3·19	2607	3·39	2016	2·62	591	0·77
July	5·32	5·35	4·77	3·21	−0·05	− 38	2675	3·48	2637	3·43	2029	2·64	608	0·79
August	5·27	5·19	4·66	3·06	−0·23	−177	2665	3·47	2488	3·24	2005	2·61	483	0·63
September	5·04	4·90	4·59	2·79	−0·22	−169	2768	3·60	2599	3·38	1966	2·56	633	0·82
October	4·82	4·74	4·09	2·64	−0·10	− 77	2366	3·08	2289	2·98	1941	2·53	348	0·45
November	4·72	4·69	3·87	2·59	−0·20	−154	2177	2·83	2023	2·63	1893	2·46	130	0·17
December	4·52	4·35	3·55	1·98	−0·19	−146	1978	2·57	1832	2·38	1885	2·45	− 53	−0·07
1873														
January	4·33	4·31	3·51	1·94	+0·01	+ 8	1967	2·56	1975	2·57	1835	2·39	140	0·18
February	4·34	4·38	3·58	2·00	+0·10	+ 77	1992	2·59	2069	2·69	1792	2·33	277	0·36
March	4·44	4·50	3·69	2·12	+1·04	+799	2019	2·63	2818	3·67	1796	2·34	1022	1·33
April	5·48	6·46	5·54	3·97	+1·25	+960	2592	3·37	3552	4·62	2061	2·68	1491	1·94
May	6·73	7·00	6·15	4·77	+0·23	+177	3016	3·93	3193	4·16	2217	2·89	976	1·27
June	6·96	6·92	6·18	4·70	−0·06	− 46	3121	4·06	3075	4·00	2255	2·93	820	1·07
July	6·90	6·88	6·20	4·66	−0·16	−123	3183	4·14	3060	3·98	2267	2·95	793	1·03
August	6·74	6·60	5·67	4·40	−0·35	−269	2746	3·57	2477	3·22	2231	2·90	246	0·32
September	6·39	6·18	5·27	4·00	−0·43	−330	2613	3·40	2283	2·97	2150	2·80	133	0·17
October	5·96	5·73	4·85	3·57	−0·30	−230	2486	3·24	2256	3·94	2094	2·73	162	0·21
November	5·66	5·60	4·73	3·45	+0·04	+ 31	2447	3·18	2478	3·22	2072	2·70	406	0·52
December	5·70	5·79	4·90	3·34	+0·37	+284	2381	3·10	2665	3·47	2206	2·87	459	0·60
1874														
January	6·07	6·35	5·43	3·87	+0·48	+369	2551	3·32	2920	3·80	2269	2·95	651	0·85
February	6·55	6·75	5·81	4·24	+0·47	+361	[212]2632	3·43	2993	3·90	2227	2·90	766	1·00
March	7·02	7·30	6·33	4·77	+0·22	+169	2849	3·71	3018	3·93	2221	2·89	797	1·04
April	7·24	7·19	6·22	4·66	−0·06	− 46	2812	3·66	2766	3·60	2246	2·92	520	0·68

May	7·18	7·17	6·21	4·94	+0·04	+ 31	2933	3·82	2964	3·86	2267	2·95	697	0·91
June	7·22	7·26	6·29	5·02	−0·02	− 15	2960	3·85	2975	3·87	2301	2·99	674	0·88
July	7·24	7·21	6·24	4·97	0·14	−108	2945	3·83	2837	3·69	2327	3·03	510	0·66
August	7·10	6·98	6·16	4·76	−0·44	−338	3039	3·96	2701	3·52	2267	2·95	434	0·57
September	6·66	6·34	5·42	4·15	−0·52	−400	2662	3·46	2262	2·94	2170	2·82	92	0·12
October	6·14	5·94	5·05	3·77	−0·48	−369	2551	3·32	2182	2·84	2079	2·71	103	0·13
November	5·66	5·37	4·51	3·23	−0·46	−353	2377	3·09	2024	2·63	2009	2·61	15	0·02
December	5·20	5·03	4·19	2·62	−0·32	−246	2168	2·82	1922	2·50	2005	2·61	− 83	−0·11
1875														
January	244·88	244·73	243·91	241·45	−0·32	−246	[21]1843	2·40	1597	2·08	1923	2·50	−326	−0·42
February	4·56	4·38	3·58	0·46	−0·05	− 38	[21]1579	2·06	1541	2·01	1840	2·39	−299	−0·39
March	4·51	4·64	3·82	1·77	+0·53	+047	[21]1931	2·51	2338	3·04	1860	2·42	478	0·62
April	5·04	5·44	4·57	3·24	+0·54	+415	2435	3·17	2850	3·71	1929	2·51	921	1·20
May	4·58	5·71	4·83	3·61	+0·21	+161	2428	3·16	2589	3·37	2033	2·65	556	0·72
June	5·79	5·87	4·98	3·80	+0·09	+ 69	2440	3·18	2509	3·27	2149	2·80	360	0·47
July	5·88	5·90	5·01	3·79	−0·05	− 38	2484	3·23	2446	3·18	2197	2·86	249	0·32
August	5·83	5·76	4·88	3·62	−0·17	−131	2478	3·23	2347	3·06	2176	2·83	171	0·23
September	5·66	5·55	4·68	3·53	−0·25	−192	2320	3·02	2128	2·77	2157	2·81	− 29	−0·04
October	5·41	5·27	4·41	3·15	−0·23	−177	2329	3·03	2152	2·80	2056	2·68	96	0·12
November	5·18	5·08	4·24	2·81	−0·19	−146	2402	3·13	2256	2·94	2047	2·66	209	0·28
December	4·99	4·90	4·07	2·77	+0·11	+ 84	2253	2·93	2337	3·04	2143	2·79	194	0·25
1876														
January	5·10	5·31	4·45	2·91	+0·54	+415	[27]2229	2·90	2644	3·44	2102	2·74	542	0·70
February	5·64	5·97	5·07	3·73	+0·60	+462	[27]2478	3·23	2939	3·83	2183	2·84	756	0·98
March	6·24	6·52	5·59	4·02	+0·77	+592	[27]2583	3·36	3175	4·13	2332	3·04	(43	1·10
April	7·01	7·50	6·52	5·35	+0·78	+599	2931	3·81	3530	4·59	2446	3·18	1084	1·41
May	7·79	8·08	7·06	5·95	+0·40	+307	3041	3·96	3358	4·36	2528	3·29	820	1·07
June	8·19	8·30	7·27	6·23	+0·15	+115	3023	3·93	3138	4·08	2578	3·36	560	0·72
July	8·34	8·37	7·34	6·25	−0·20	−154	3112	4·05	2958	3·85	2567	3·34	391	0·51
August	8·14	7·91	6·90	5·64	−0·54	−415	3164	4·12	2749	3·58	2465	3·21	284	0·37
September	7·60	7·30	6·33	4·99	−0·47	−361	3042	3·96	2681	3·49	2435	3·17	246	0·32
October	7·13	6·96	-6·01	4·92	−0·35	−269	2572	3·48	2403	3·13	2317	3·02	86	0·11
November	6·78	6·60	5·67	4·20	−0·27	−208	2926	3·81	2718	3·54	2365	3·08	353	0·46
December	6·51	6·42	5·50	3·67	−0·35	−269	2748	3·58	2479	3·23	2327	3·03	152	0·20
1877														
January	6·16	5·89	5·00	2·37	−0·40	−307	[27]2100	2·73	1793	2·33	2196	2·86	−403	−0·52
February	5·76	5·62	4·74	3·17	−0·06	− 46	2337	3·04	2291	2·98	2105	274	186	0·24
March	5·70	5·77	4·89	3·57	+0·42	+323	2452	3·19	2775	3·61	2041	2·66	734	0·96
April	6·12	6·46	5·54	3·80	+0·38	+292	2706	3·52	2998	3·90	2124	2·76	874	1·14
May	6·50	6·53	5·60	4·51	−0·02	− 15	2546	3·31	2531	3·29	2181	2·84	350	0·45
June	6·48	6·43	5·51	4·38	−0·03	− 23	2560	3·33	2537	3·30	2217	2·89	320	0·41
July	6·45	6·47	5·55	4·56	−0·11	− 84	2424	3·15	2340	3·04	2294	2·99	46	0·05
August	6·34	6·20	5·29	4·05	−0·36	−277	2549	3·38	2317	3·02	2239	2·91	78	0·11
September	5·98	5·77	4·89	3·51	−0·42	−323	2580	3·36	2257	2·94	2234	2·91	23	0·03
October	5·56	5·34	4·48	2·90	−0·26	−200	2586	3·37	2386	3·11	2152	2·80	234	0·31
November	5·30	5·52	4·40	3·00	+0·02	+ 15	2433	3·17	2448	3·19	2159	2·81	289	0·38
December	5·32	5·38	4·52	2·99	+0·11	+ 84	2245	2·92	2329	3·03	2225	2·90	104	0·13

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
Note.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24 and 27, respectively.

TABLE 27—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of— Lake Ontario. Oswego, N.Y.		Water Levels of— St. Lawrence River.		Storage in Lake Ontario.		Outflow through St. Lawrence River.		Total Supply to Lake Ontario.		Inflow from Niagara River.		Local Supply to Lake Ontario.	
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1878														
January	5·43	5·48	4·61	2·97	+0·15	+115	[27]2273	2·96	2388	3·11	2213	2·88	175	0·23
February	5·58	5·69	4·81	3·20	+0·46	+353	[27]2342	3·05	2695	3·51	2195	2·86	500	0·65
March	6·04	5·39	5·47	4·01	+0·48	+369	2493	3·24	2862	3·72	2213	2·88	649	0·84
April	6·52	6·64	5·71	4·63	+0·29	+223	2570	3·34	2793	3·63	2298	2·99	495	0·64
May	6·81	6·98	6·03	5·20	+0·17	+131	2370	3·08	2501	3·25	2356	3·07	145	0·18
June	6·97	6·97	6·02	4·74	−0·03	− 23	2875	3·74	2852	3·71	2375	3·09	477	0·62
July	6·95	6·93	5·98	4·63	−0·06	− 46	2930	3·81	2884	3·75	2393	3·11	491	0·64
August	6·89	6·85	5·90	4·53	−0·17	−131	2920	3·80	2789	3·63	2317	3·02	472	0·61
September	6·72	6·59	5·66	4·31	−0·26	−200	2816	3·66	2616	3·40	2298	2·99	318	0·41
October	6·64	6·33	5·41	3·99	−0·19	−146	2792	3·63	2646	3·44	2227	2·90	419	0·54
November	6·27	6·21	5·30	3·84	+0·35	+269	2786	3·63	3055	3·98	2206	2·87	849	1·11
December	6·62	7·02	6·06	4·95	+0·30	+230	2711	3·53	2941	3·83	2271	2·96	670	0·87
1879														
January	6·92	6·81	5·87	3·39	−0·29	−223	[27]2398	312·	2175	2·83	2137	2·78	38	0·05
February	6·63	6·45	5·53	3·75	−0·25	−192	[21]2378	3·10	2186	2·85	2055	2·67	131	0·17
March	6·38	6·30	5·39	3·81	+0·12	+ 92	[21]2381	3·10	2473	3·22	2051	2·67	422	0·55
April	6·50	5·71	5·77	4·36	+0·26	+200	2550	3·32	2750	3·58	2118	2·76	632	0·82
May	6·76	6·80	5·86	4·44	+0·06	+ 46	2950	3·84	2996	3·90	2149	2·80	847	1·10
June	6·82	6·83	5·88	4·54	−0·07	− 54	2882	3·75	2828	3·68	2187	2·85	641	0·83
July	6·75	6·67	5·73	4·50	0·25	−192	2727	3·55	2535	3·30	2213	2·88	322	0·42
August	6·50	6·32	5·40	3·86	−0·39	−300	2884	3·75	2584	3·36	2140	2·79	444	0·57
September	6·11	5·90	5·01	3·45	−0·43	−330	2759	3·59	2429	3·16	2077	2·70	352	0·46
October	5·68	5·46	4·59	2·86	−0·42	−323	2724	3·55	2401	3·13	2038	2·65	363	0·48
November	5·26	5·07	4·23	2·94	−0·18	−138	2297	2·99	2159	2·81	1956	2·55	203	0·26
December	5·08	5·10	4·25	2·90	+0·13	+100	2346	3·05	2446	3·18	2059	2·68	387	0·50
1880.														
January	245·21	245·32	244·46	243·03	+0·25	+192	2165	2·82	2357	3·07	2146	2·79	211	0·28
February	5·46	5·60	4·73	3·48	+0·31	+238	2424	3·15	2662	3·46	2103	2·74	559	0·73
March	5·77	5·94	5·05	3·60	+0·26	+200	2355	3·07	2555	3·33	2124	2·76	431	0·57
April	6·03	6·12	5·22	4·04	+0·17	+131	2513	3·27	2644	3·44	2145	2·79	499	0·65

May.........	6·20	6·27	5·36	4·14	+0·19	+146	2599	3·38	2745	3·57	2207	2·87	538	0·70
June.........	6·39	6·51	5·58	4·33	+0·13	+100	2696	3·51	2796	3·64	2251	2·93	545	0·71
July.........	6·52	6·52	5·59	4·33	−0·22	−169	2710	3·53	2541	3·31	2291	2·98	250	0·33
August......	6·30	6·09	5·19	3·91	−0·40	−307	2597	3·38	2290	2·98	2213	2·88	77	0·10
September..	5·90	5·72	4·84	3·60	−0·38	−292	2449	3·19	2157	2·81	2172	2·83	− 15	−0·02
October.....	5·52	5·31	4·45	3·27	−0·23	−177	2276	2·96	2099	2·73	2081	2·71	18	0·02
November..	5·29	5·27	4·41	3·29	−0·11	− 84	2212	2·88	2128	2·77	2088	2·72	40	0·05
December...	5·18	5·10	4·25	2·74	−0·26	−200	2152	2·80	1952	2·54	2055	2·67	−103	−0·13
1881.														
January.....	4·92	4·74	3·91	1·02	−0·18	−138	^{27}1726	2·25	1588	2·07	1931	2·51	−343	−0·45
February....	4·74	4·73	3·91	1·56	+0·32	+246	^{21}1723	2·24	1969	2·56	1908	2·48	61	0·08
March.......	5·06	5·39	4·53	2·83	+0·54	+415	^{21}2230	2·90	2645	3·44	1968	2·56	677	0·88
April........	5·60	5·81	4·92	3·53	+0·30	+230	2598	3·38	2828	3·68	2112	2·75	716	0·93
May.........	5·90	5·99	5·09	3·72	+0·20	+154	2641	3·44	2795	3·64	2205	2·87	590	0·77
June.........	6·10	6·21	5·30	3·93	+0·14	+108	2710	3·53	2818	3·67	2281	2·97	537	0·70
July.........	6·24	6·28	5·37	4·04	−0·12	− 92	2699	3·51	2607	3·39	2286	2·98	321	0·41
August.. ...	6·12	5·96	5·06	3·72	−0·44	−338	2605	3·39	2267	2·95	2188	2·85	79	0·10
September..	5·68	5·40	4·54	3·39	−0·39	−300	2278	2·96	1978	2·57	2119	2·76	−141	−0·19
October.....	5·29	5·18	4·33	3·02	−0·11	− 84	2343	3·05	2259	2·94	2121	2·76	138	0·18
November..	5·18	5·18	4·33	3·06	0·00	0	2313	3·01	2313	3·01	2105	2·74	208	0·27
December...	5·18	5·18	4·33	3·10	+0·28	−215	2281	2·97	2496	3·25	2200	2·86	296	0·39
1882.														
January.....	5·46	5·73	4·85	3·20	+0·36	+277	^{27}2342	3·05	2619	3·41	2283	2·97	336	0·44
February....	5·82	5·90	5·01	3·44	+0·38	+292	^{21}2387	3·11	2679	3·49	2229	2·90	450	0·59
March.......	6·20	6·50	5·57	4·07	+0·46	+353	2553	3·32	2906	3·78	2330	3·03	576	0·75
April........	6·66	6·83	5·88	4·84	+0·26	+200	2579	3·36	2779	3·62	2367	3·08	412	0·54
May.........	6·92	7·02	6·06	4·69	+0·36	+277	2975	3·87	3252	4·23	2416	3·14	836	1·09
June.........	7·28	7·53	6·54	5·40	+0·24	+184	2901	3·78	3085	4·02	2474	3·22	611	0·80
July.........	7·52	7·52	6·54	5·34	−0·16	−123	2970	3·87	2847	3·71	2474	3·22	373	0·49
August......	7·36	7·19	6·22	4·95	−0·36	−277	2937	3·82	2660	3·46	2416	3·14	244	0·32
September..	7·00	6·81	5·87	4·46	−0·44	−338	2946	3·83	2608	3·39	2362	3·07	246	0·32
October.....	6·56	6·30	5·39	4·10	−0·47	−361	2670	3·47	2309	3·00	2265	2·95	44	0·05
November..	6·09	5·88	4·99	3·67	−0·35	−269	2566	3·34	2297	2·99	2213	2·88	84	0·11
December...	5·74	5·59	4·72	3·51	−0·28	−215	2385	3·10	2170	2·82	2135	2·78	35	0·04
1883.														
January.....	5·46	5·32	4·46	1·87	−0·11	− 84	^{27}1915	2·55	1875	2·44	2084	2·71	−209	−0·27
February....	5·35	5·38	4·52	2·01	+0·15	+115	^{24}1872	2·44	1987	2·59	2081	2·71	− 94	−0·12
March.......	5·50	5·62	4·74	2·76	+0·38	+292	^{24}2213	2·88	2505	3·26	2115	2·75	390	0·51
April........	5·88	6·14	5·23	3·78	+0·58	+446	2411	3·14	2857	3·72	2126	2·77	731	0·95
May.........	6·46	6·79	5·85	4·56	+0·68	+522	2827	3·68	3349	4·36	2234	2·91	1115	1·45
June.........	7·14	7·49	6·51	5·37	+0·62	+476	2892	3·76	3368	4·38	2427	3·16	941	1·22
July.........	7·76	8·02	7·01	5·77	+0·17	+131	3180	4·14	3311	4·31	2500	3·25	811	1·06
August......	7·93	7·84	6·84	5·58	−0·33	−254	3141	4·09	2887	3·76	2462	3·20	425	0·56
September..	7·60	7·36	6·38	5·10	−0·46	−353	3001	3·91	2648	3·45	2397	3·12	251	0·33
October.....	7·14	6·92	5·97	4·66	−0·34	−261	2886	3·76	2625	3·42	2332	3·04	293	0·38
November..	6·80	6·69	5·75	4·59	−0·18	−138	2664	3·47	2526	3·29	2265	2·95	261	0·34
December...	6·62	6·55	5·62	4·42	−0·09	− 69	2662	3·46	2593	3·37	2320	3·02	273	0·35

a.—Niagara River discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.
NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of—				Storage in Lake Ontario.		Outflow through St. Lawrence River.		Total Supply to Lake Ontario.		Inflow from Niagara River.		Local Supply to Lake Ontario.	
	Lake Ontario.		St. Lawrence River.											
	Oswego, N.Y.													
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1884.														
January	6·53	6·51	5·58	3·29	+0·17	+131	[24]2184	2·84	2315	3·01	2206	2·87	109	0·14
February	6·70	6·88	5·93	3·76	+0·52	+400	[24]2324	3·02	2724	3·55	2215	2·88	509	0·66
March	7·22	7·56	6·57	4·46	+0·64	+492	[27]2724	3·55	3216	4·19	2248	2·93	968	1·26
April	7·86	8·17	7·15	5·71	+0·32	+246	3029	3·94	3275	4·26	2370	3·08	905	1·18
May	8·18	8·19	7·17	5·92	−0·04	− 31	3248	4·23	3217	4·19	2436	3·17	781	1·02
June	8·14	8·00	7·07	5·81	−0·16	−123	3224	4·20	3101	4·04	2475	3·22	626	0·81
July	7·98	7·88	6·87	5·61	−0·22	−169	3153	4·10	2984	3·88	2436	3·17	548	0·71
August	7·76	7·65	6·66	5·52	−0·32	−246	2944	3·83	2698	3·51	2375	3·09	323	0·42
September	7·44	7·22	6·39	5·15	−0·43	−330	2963	3·86	2633	3·43	2281	2·97	352	0·46
October	7·01	6·80	5·97	4·67	−0·46	−353	2876	3·74	2523	3·28	2215	2·88	308	0·40
November	6·55	6·30	5·55	4·33	−0·33	−254	2657	3·46	2403	3·13	2126	2·77	277	0·36
December	6·22	6·15	5·24	4·13	−0·08	− 62	2454	3·19	2392	3·11	2155	2·80	237	0·31
1885.														
January	246·14	246·14	245·23	243·73	−0·14	−108	[24]2270	2·95	2162	2·81	2081	2·71	81	0·11
February	6·00	5·87	4·98	2·52	−0·27	−208	[24]2121	2·76	1913	2·49	1984	2·58	− 71	−0·09
March	5·73	5·59	4·72	2·73	+0·20	+154	[24]2197	2·86	2351	3·06	1941	2·53	410	0·53
April	5·93	6·27	5·36	3·69	+0·74	+569	2600	3·38	3169	4·12	2112	2·75	1057	1·37
May	6·67	7·07	6·11	4·96	+0·59	+453	2771	3·61	3224	4·20	2286	2·98	938	1·22
June	7·26	7·44	6·47	5·35	+0·25	+192	2855	3·72	3047	3·97	2434	3·17	613	0·80
July	7·51	7·58	6·50	5·45	−0·01	− 8	2920	3·80	2912	3·79	2441	3·18	471	0·61
August	7·50	7·43	6·45	5·30	−0·18	−138	2884	3·75	2746	3·57	2423	3·15	323	0·42
September	7·32	7·21	6·24	5·11	−0·20	−154	2792	3·63	2638	3·43	2400	3·12	238	0·31
October	7·12	7·02	6·05	4·87	−0·08	− 62	2784	3·62	2722	3·54	2390	3·11	332	0·43
November	7·04	7·07	6·11	4·86	+0·12	+ 92	2877	3·74	2969	3·86	2387	3·11	582	0·75
December	7·16	7·24	6·27	5·07	+0·26	+200	2879	3·75	3079	4·01	2423	3·15	656	0·86
1886.														
January	7·42	7·60	6·61	5·15	+0·22	+169	[27]2787	3·63	2956	3·85	2395	3·12	561	0·73
February	7·64	7·67	6·68	5·06	+0·10	+ 77	[21]2397	3·12	2474	3·22	2159	2·81	315	0·41
March	7·74	7·81	6·81	5·02	+0·38	+292	[21]2693	3·51	2985	3·88	2103	2·74	882	1·54
April	8·12	8·43	7·39	5·90	+0·42	+323	3159	4·11	3482	4·53	2298	2·99	1184	1·51

May	8·54	8·64	7·59	·49	0·00	0	3208	4·18	3208	4·18	2372	3·09	836	1·09
June	8·54	8·44	7·40	6·28	−0·30	−230	3172	4·13	2942	3·83	2416	3·14	526	0·69
July	8·24	8·04	7·03	5·83	−0·42	−323	3140	4·09	2817	3·67	2428	3·16	389	0·51
August	7·82	7·60	6·61	5·47	−0·40	−307	2928	3·81	2621	3·41	2357	3·07	264	0·34
September	7·42	7·24	6·27	5·16	−0·32	−246	2780	3·62	2534	3·30	2307	3·00	227	0·30
October	7·10	6·95	6·00	4·76	−0·37	−284	2829	3·68	2545	3·31	2267	2·95	278	0·36
November	6·73	6·51	5·58	4·62	−0·27	−208	2399	3·12	2191	2·85	2222	2·89	− 31	−0·04
December	6·46	6·42	5·50	4·31	−0·16	−123	2614	3·40	2491	3·24	2246	2·92	245	0·32
1887.														
January	6·30	6·17	5·26	3·97	+0·24	+184	[21]2460	3·20	2644	3·44	2161	2·81	483	0·63
February	6·54	6·92	5·97	4·22	+0·64	+492	[27]2650	3·45	3142	4·09	2212	2·88	930	1·21
March	7·18	7·43	6·45	4·69	+0·36	+277	[27]2796	3·64	3073	4·00	2383	3·10	690	0·90
April	7·54	7·64	6·65	5·39	+0·38	+292	3075	4·00	3367	4·38	2372	3·09	995	1·29
May	7·92	8·20	7·14	5·91	+0·26	+200	3212	4·18	3412	4·44	2427	3·16	985	1·28
June	8·18	8·16	7·08	5·95	−0·16	−123	3074	4·00	2951	3·84	2465	3·21	486	0·63
July	8·02	7·88	6·90	5·67	−0·40	−307	3128	4·07	2821	3·67	2423	3·15	398	0·52
August	7·62	7·37	6·39	5·17	−0·56	−430	2942	3·83	2512	3·27	2322	3·02	190	0·25
September	7·06	6·76	5·82	4·72	−0·50	−384	2624	3·42	2240	2·92	2244	2·92	− 4	0·00
October	6·56	6·37	5·45	4·40	−0·36	−277	2458	3·20	2181	2·84	2258	2·94	− 77	−0·10
November	6·20	6·02	5·12	3·90	−0·32	−246	2519	3·28	2273	2·96	2125	2·77	148	0·19
December	5·88	5·75	4·87	3·64	−0·28	−215	2449	3·19	2234	2·91	2170	2·82	64	0·09
1888.														
January	5·60	5·44	4·57	3·49	−0·23	−177	2225	2·90	2048	2·67	2094	2·73	− 46	−0·06
February	5·37	5·30	4·44	2·27	+0·05	+ 38	[24]1996	2·60	2034	2·65	1954	2·54	80	0·10
March	5·42	5·54	4·67	2·27	+0·44	+338	[27]2072	2·70	2410	3·14	1971	2·57	439	0·57
April	5·86	6·17	5·26	4·05	+0·34	+261	2555	3·33	2816	3·67	2121	2·76	695	0·91
May	6·20	6·24	5·33	4·20	+0·06	+ 46	2500	3·25	2546	3·31	2157	2·81	389	0·50
June	6·26	6·28	5·37	4·23	+0·05	+ 38	2523	3·28	2561	3·33	2197	2·86	364	0·47
July	6·31	6·34	5·42	4·22	−0·02	− 15	2599	3·38	2584	3·36	2251	2·93	333	0·43
August	6·29	6·24	5·33	4·08	−0·25	−192	2615	3·40	2423	3·15	2225	2·90	198	0·25
September	6·04	5·85	4·96	3·91	−0·37	−284	2311	3·01	2027	2·64	2142	2·79	−115	−0·15
October	5·67	5·49	4·62	3·26	−0·21	−161	2475	3·22	2314	3·01	2098	2·73	216	0·28
November	5·46	5·42	4·56	3·17	−0·04	− 31	2478	3·23	2447	3·19	2064	2·69	383	0·50
December	5·42	5·41	4·55	3·30	+0·10	+ 77	2366	3·08	2443	3·18	2133	2·78	310	0·40
1889.														
January	5·52	5·62	4·74	3·51	+0·17	+131	2408	3·13	2539	3·30	2091	2·72	448	0·58
February	5·69	5·76	4·88	2·87	+0·15	+115	[21]2207	2·87	2322	3·02	2041	2·66	281	0·37
March	5·84	5·93	5·04	3·43	+0·21	+161	[24]2283	2·97	2444	3·18	1952	2·54	492	0·64
April	6·05	6·17	5·26	4·01	+0·19	+146	2594	3·38	2740	3·57	2038	2·65	702	0·92
May	6·24	6·32	5·40	4·19	+0·24	+184	2601	3·39	2785	3·63	2075	2·70	710	0·93
June	6·48	6·63	5·70	4·51	+0·24	+184	2678	3·49	2862	3·73	2186	2·85	676	0·88
July	6·72	6·82	5·88	4·61	−0·02	− 15	2819	3·67	2804	3·65	2196	2·86	608	0·79
August	6·70	6·57	5·64	4·35	−0·41	−315	2754	3·58	2439	3·17	2174	2·83	265	0·34
September	6·29	6·01	5·11	3·83	−0·50	−384	2571	3·35	2187	2·85	2084	2·71	103	0·14
October	5·79	5·57	4·70	3·12	−0·42	−323	2666	3·47	2343	3·05	1970	2·56	373	0·49
November	5·37	5·17	4·32	3·15	+0·09	+ 69	2228	2·90	2297	2·99	1970	2·56	327	0·43
December	5·46	5·74	4·86	3·46	+0·54	+415	2264	2·95	2679	3·49	2041	2·66	638	0·83

a.—Niagara River discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.
NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24 and 27, respectively.

Table 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of—				Storage in Lake Ontario.		Outflow through St. Lawrence River.		Total Supply to Lake Ontario.		Inflow from Niagara River.		Local Supply to Lake Ontario.	
	Lake Ontario. Oswego, N.Y.		St. Lawrence River.											
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal. Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1890														
January	246·00	246·25	244·34	245·10	+0·42	+323	[24]2589	3·37	2912	3·79	2178	2·83	734	0·96
February	6·42	6·60	5·67	4·13	+0·34	+261	2614	3·40	2875	3·74	2133	2·78	742	0·96
March	6·76	6·93	5·98	4·64	+0·29	+223	[24]2748	3·58	2971	3·87	2191	2·85	780	1·02
April	7·05	7·17	6·21	4·98	+0·30	+230	2890	3·76	3120	4·06	2251	2·93	869	1·13
May	7·35	7·53	6·59	5·26	+0·49	+376	3128	4·07	3504	4·56	2342	3·05	1162	1·51
June	7·84	8·16	7·00	5·89	+0·24	+184	3020	3·93	3204	4·17	2426	3·16	778	1·01
July	8·08	7·99	6·97	5·74	−0·42	−323	3155	4·11	2832	3·69	2354	3·06	478	0·62
August	7·66	7·32	6·12	5·09	−0·52	−400	2643	3·44	2243	2·92	2237	2·91	6	−0·01
September	7·14	6·97	6·02	4·75	−0·34	−261	2866	3·73	2605	3·39	2152	2·80	453	0·59
October	6·80	6·64	5·71	4·38	−0·12	− 92	2816	3·66	2724	3·54	2150	2·80	574	0·74
November	6·68	6·72	5·78	4·32	−0·06	− 46	2956	3·85	2910	3·79	2196	2·86	714	0·93
December	6·62	6·51	5·58	3·44	−0·27	−208	2591	3·37	2383	3·10	2133	2·78	250	0·32
1891														
January	6·35	6·19	5·28	3·41	−0·03	− 23	[27]2404	3·13	2381	3·10	2072	2·70	309	0·40
February	6·32	6·45	5·53	3·48	+0·40	+307	[27]2425	3·16	2732	3·56	2046	2·66	686	0·89
March	6·72	6·99	6·04	4·30	+0·51	+392	[24]2649	3·45	3041	3·96	2077	2·70	964	1·25
April	7·23	7·47	6·49	5·13	+0·13	+100	3122	4·06	3222	4·19	2106	2·74	1116	1·45
May	7·36	7·25	6·28	4·93	−0·32	−246	3033	3·95	2787	3·63	2054	2·67	733	0·96
June	7·04	6·83	5·72	4·52	−0·35	−269	2693	3·51	2424	3·16	2050	2·67	374	0·49
July	6·69	6·55	5·49	4·38	−0·36	−277	2530	3·29	2253	2·93	2091	2·72	162	0·21
August	6·33	6·11	5·07	3·99	−0·43	−330	2374	3·09	2044	2·66	2025	2·64	19	0·02
September	5·90	5·68	4·71	3·50	−0·54	−415	2382	3·10	1967	2·56	1986	2·58	− 19	−0·02
October	5·36	5·04	4·29	2·83	−0·62	−476	2440	3·18	1964	2·56	1903	2·48	61	0·08
November	4·74	4·44	3·99	2·59	−0·32	−246	2299	2·99	2053	2·67	1891	2·46	1·62	0·21
December	4·42	4·41	3·60	2·42	+0·04	+ 31	2023	2·63	2054	2·67	1897	2·47	1·57	0·20
1892														
January	4·46	4·51	3·70	2·33	+0·04	+ 31	[24]2089	2·72	2120	2·76	1878	2·44	242	0·31
February	4·50	4·48	3·67	1·83	+0·04	+ 31	[21]1851	2·41	1882	2·45	1733	2·26	149	0·19
March	4·54	4·61	3·79	1·98	+0·36	+277	[21]1974	2·57	2251	2·93	1775	2·31	476	0·62
April	4·90	5·19	4·34	2·97	+0·32	+246	2392	3·11	2638	3·43	1954	2·54	684	+0·89

May.........	5·22	5·25	4·40	3·16	+0·31	+238	2310	3·01	2548	3·32	2054	2·67	494	0·65
June.........	5·53	5·81	4·92	3·59	+0·53	+407	2549	3·32	2956	3·85	2246	2·92	710	0·93
July.........	6·06	6·32	5·26	4·21	+0·22	+169	2400	3·12	2569	3·34	2299	2·99	270	0·35
August......	6·28	6·24	5·15	4·03	−0·14	−108	2436	3·17	2328	3·03	2208	2·87	120	0·16
September..	6·14	6·04	5·21	3·87	−0·32	−246	2655	3·46	2409	3·14	2143	2·79	266	0·35
October.....	5·82	5·60	4·67	3·44	−0·36	−277	2387	3·11	2110	2,75	2066	2·69	44	0·06
November..	5·46	5·33	4·36	3·09	−0·20	−154	2323	3·02	2169	2·82	1978	2·57	191	0·25
December..	5·26	5·20	4·35	3·10	−0·22	−169	2304	3·00	2135	2·78	1973	2·57	162	0·21
1893														
January.....	5·04	4·87	4·04	2·27	−0·22	−169	[21]1752	2·28	1583	2·06	1806	2·35	−223	−0·29
February....	4·82	4·76	3·93	1·71	+0·18	+138	[27]1915	2·49	2053	2·67	1796	2·34	257	0·33
March.......	5·00	5·24	4·39	2·29	+0·62	+476	[27]2077	2·70	2553	3·32	1861	2·42	692	0·90
April........	5·62	5·99	5·09	3·66	+0·95	+730	2353	3·06	3083	4·01	2006	2·61	1077	1·40
May.........	6·57	7·15	6·19	4·80	+0·69	+530	3040	3·96	3570	4·65	2174	2·83	1396	1·82
June.........	7·26	7·37	6·39	5·12	−0·02	− 15	2994	3,90	2979	3·88	2258	2·94	721	0·94
July.........	7·24	7·11	6·15	4·81	−0·40	−307	2980	3·88	2673	3·48	2224	2·89	449	0·59
August......	6·48	6·57	5·64	4·27	−0·40	−307	2826	3·68	2519	3·28	2086	2·71	433	0·57
September...	6·44	6·30	5·39	4·17	−0·40	−307	2608	3·39	2301	2·99	2028	2·64	273	0·35
October.....	6·04	5·78	4·90	3·60	−0·46	−353	2519	3·28	2166	2·82	2006	2·61	160	0·21
November..	5·58	5·37	4·51	3·20	−0·28	−215	2400	3·12	2185	2·84	2001	2·60	184	0·24
December...	5·30	5·22	4·37	3·08	+0·09	+ 69	2339	3·04	2408	3·13	1993	2·59	415	0·54
1894														
January.....	5·39	5·56	4·69	3·16	+0·26	+200	2297	2·99	2497	3·35	1993	2·59	504	0·66
February....	6·65	5·74	4·86	2·44	+0·24	+184	[21]1990	2·59	2174	2,83	1908	2·48	266	0·35
March.......	5·89	6·04	5·14	3·49	+0·17	+131	[27]2428	3·16	2559	3·33	1931	2·51	628	0·82
April........	6·06	6·09	5·19	3·82	+0·12	+ 92	2673	3·49	2765	3·60	1974	2·57	791	1·03
May.........	6·18	6·27	5·36	4·04	+0·36	2,687	2687	3·50	2964	3·86	2088	2·72	876	1·14
June.........	6·54	6·80	5·86	4·61	+0·16	+123	2793	3·64	2916	3·80	2181	2·84	735	0·96
July.........	6·70	6·60	5·67	4·40	−0·39	−300	2746	3·57	2446	3·18	2150	2·80	296	0·38
August......	6·31	6·02	5·12	3·81	−0·55	−423	2600	3·38	2177	2·83	2040	2·66	137	0·17
September..	5·76	5·51	4·64	3·37	−0·38	−292	2410	3·14	2118	2·76	2002	2·61	116	0·15
October.....	5·38	5·26	4·40	3·15	−0·28	−215	2319	3·02	2104	2·74	2002	2·61	102	0·13
November..	5·10	4·93	4·09	2·95	−0·34	−261	2136	2·78	1875	2·44	1962	2·55	− 87	−0·11
December...	4·76	4·58	3·76	2·39	−0·22	−169	2206	2·87	2037	2·65	1923	2·50	114	0·15
1895														
January.....	244·54	244·49	342·68	242·16	−0·08	− 62	1989	2·59	1927	2·51	1896	2·47	31	0·04
February....	4·46	4·43	3·62	1·32	−0·08	− 62	[21]1659	2·16	1597	2·08	1749	2·28	−152	0·20
March.......	4·38	4·33	3·53	1·59	+0·22	+169	[21]1774	2·31	1943	2·53	1733	2·26	210	0·27
April........	4·60	4·88	4·05	2·64	+0·34	+261	2034	2·65	2295	2·99	1777	2·31	518	0·68
May.........	4·94	5·00	4·16	2·97	0·00	0	2197	2·86	2197	2·86	1850	2·41	347	0·45
June.........	4·94	4·88	4·05	2·81	−0·20	−154	2202	2·87	2048	2·67	1872	2·44	176	0·23
July.........	4·74	4·59	3·77	2·51	−0·28	−215	2134	2·78	1919	2·50	1867	2·43	52	0·07
August......	4·46	4·34	3·54	2·36	−0·29	−223	2006	2·61	1783	2·32	1838	2·39	− 55	−0·07
September..	4·17	4·00	3·22	2·11	−0·34	−261	1866	2·43	1605	2·09	1842	2·40	−237	−0·31
October.....	3·83	3·66	2·90	1·77	−0·29	−223	1794	2·33	1571	2·04	1792	2·33	−221	−0·29
November..	3·54	3·41	2·66	1·56	−0·12	− 92	1710	2·23	1618	2·11	1691	2·20	− 73	−0·09
December...	3·42	3·44	2·69	1·72	+0·20	+1·54	1625	2·11	1779	2·31	1744	2·27	35	0·04

a.—Niagara River discharge values include a flow of 1000 c. f. s. through Erie Canal and 1100 c. f. s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of— Lake Ontario. Oswego, N.Y. First of Month.	Mean of Month.	St. Lawrence River. Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, Mean of Month.	Storage in Lake Ontario. Foot Depth.	100 c.f.s.	Outflow through St. Lawrence River. 100 c.f.s.	Feet Depth, Lake Ontario.	Total Supply to Lake Ontario. 100 c.f.s.	Feet Depth.	Inflow from Niagara River. 100 c.f.s.	Feet Depth, Lake Ontario.	Local Supply to Lake Ontario. 100 c.f.s.	Foot Depth.
1896														
January	3·62	3·80	3·03	1·80	+0·41	+315	[24]1825	2·38	2140	2·79	1775	2·31	365	0·48
February	4·03	4·26	3·46	1·93	+0·35	+269	1932	2·51	2201	2·86	1760	2·29	441	0·57
March	4·38	4·49	3·68	1·86	+0·57	+438	[27]1956	2·55	2394	3·12	1687	2·20	707	0·92
April	4·95	5·41	4·55	3·06	+0·47	+361	2230	2·90	2591	3·37	1796	2·34	795	1·03
May	5·42	4·53	4·57	3·46	−0·03	− 23	2252	2·93	2229	2·90	1891	2·46	338	0·44
June	5·39	5·35	4·49	3·29	−0·17	−131	2306	3·00	2175	2·83	1893	2·46	282	0·37
July	5·22	5·08	4·42	3·17	−0·21	−161	2120	2·76	1959	2·55	1932	2·51	27	0·04
August	5·01	4·94	4·10	3·02	−0·31	−238	2088	2·72	1850	2·41	1983	2·58	−133	−0·17
September	4·70	4·46	3·65	2·54	−0·36	−277	1985	2·58	1708	2·22	1891	2·46	−183	−0·24
October	4·34	4·23	3·43	2·32	−0·24	−184	1928	2·50	1740	2·26	1836	2·39	−96	−0·13
November	4·10	3·97	3·19	2·22	−0·13	−100	1754	2·28	1654	2·15	1842	2·40	−188	−0·25
December	3·97	3·97	3·19	2·04	−0·05	− 38	1648	2·14	1610	2·09	1797	2·34	−187	−0·25
1897														
January	3·92	3·88	3·10	1·91	−0·07	− 54	1890	2·46	1836	2·39	1875	2·44	− 39	−0·05
February	3·85	3·82	3·05	1·75	+0·22	+169	[24]1783	2·32	1952	2·54	1781	2·32	171	0·22
March	4·07	4·32	3·52	2·25	+0·57	+438	[21]1976	2·57	2414	3·14	1888	2·46	526	0·68
April	4·64	4·96	4·12	3·12	+0·54	+415	2022	2·63	2437	3·17	2004	2·61	433	0·56
May	5·18	5·40	4·54	3·34	+0·32	+246	2321	3·02	2567	3·34	2101	2·73	466	0·61
June	5·50	5·61	4·73	3·73	+0·11	+ 84	2198	2·86	2282	2·97	2097	2·73	185	0·24
July	5·61	5·61	4·73	3·64	−0·01	− 8	2280	2·97	2272	2·96	2093	2·72	179	0·24
August	5·60	5·60	4·73	3·63	−0·25	−192	2290	2·98	2098	2·73	2066	2·69	32	0·04
September	5·35	5·10	4·25	3·07	−0·57	−438	2215	2·88	1777	2·31	1948	2·25	−207	−0·27
October	4·78	4·47	3·66	2·57	−0·34	−261	1972	2·57	1711	2·23	1886	2·45	−175	−0·22
November	4·44	4·41	3·60	2·30	0·00	0	2108	2·74	2108	2·74	1895	2·47	213	0·27
December	4·44	4·47	3·66	2·37	+0·12	+ 92	2120	2·76	2212	2·88	1921	2·50	291	0·38
1898														
January	4·56	4·64	3·82	2·44	+0·30	+230	[24]2074	2·70	2304	3·00	1893	2·46	411	0·53
February	4·86	5·08	4·24	2·52	+0·42	+323	[21]2143	2·79	2466	3·21	1870	2·43	596	0·78
March	5·28	5·48	4·61	3·58	+0·42	+233	1191	2·85	2514	3·27	1951	2·54	563	0·73
April	5·70	5·92	5·03	3·21	+0·30	+230	2580	3·36	2810	3·66	2088	2·72	722	0·49

May........	6·00	6·08	5·18	3·54	+0·10	+ 77	2878	3·75	2955	3·85	2119	2·76	836	1·09
June........	6·10	6·13	5·23	3·59	−0·11	− 84	2898	3·77	2814	3·66	2128	2·77	686	0·89
July........	5·99	5·85	4·96	3·32	−0·31	−238	2801	3·65	2563	3·34	2077	2·70	486	0·64
August......	5·68	5·50	4·63	3·24	−0·38	−292	2501	3·26	2209	2·88	2068	2·69	141	0·19
September..	5·30	5·09	4·24	2·85	−0·34	−261	2372	3·09	2111	2·75	1981	2·58	130	0·17
October.....	4·96	4·84	4·01	2·58	−0·10	77	2327	3·03	2250	2·93	1943	2·53	307	0·40
November..	4·86	4·89	4·06	2·56	+0·04	+ 31	2390	3·11	2421	3·15	1965	2·56	456	0·59
December...	4·90	4·90	4·07	2·61	+0·01	+ 31	2069	2·69	2100	2·73	1978	2·57	122	0·16
1899														
January.....	4·94	4·98	4·14	2·70	−0·01	− 8	2078	2·70	2070	2·69	1974	2·57	96	0·12
February....	4·93	4·88	4·05	2·24	+0·07	+ 54	[24]2063	2·69	2117	2·76	1875	2·44	242	0·31
March.......	5·00	5·13	4·28	2·72	+0·41	+315	2190	2·85	2505	3·26	1929	2·51	576	0·75
April........	5·41	5·69	4·81	3·35	+0·41	+315	2289	2·98	2604	3·39	1973	2·57	631	0·82
May.........	5·82	5·94	5·05	3·66	+0·18	+138	2644	3·44	2782	3·62	2036	2·65	746	0·97
June.........	6·00	6·07	5·17	3·84	0·00	0	2634	3·43	2634	3·43	2079	2·71	555	0·72
July.........	6·00	5·92	5·03	3·68	−0·31	−238	2603	3·39	2365	3·08	2066	2·69	299	0·39
August......	5·69	5·46	4·59	3·27	−0·49	−376	2434	3·17	2058	2·68	1983	2·58	750	0·10
September..	5·20	4·95	4·11	2·81	−0·45	−346	2266	2·95	1920	2·50	1941	2·53	− 21	−0·03
October.....	4·75	4·55	3·74	2·40	−0·27	−208	2180	2·84	1972	2·57	1850	2·41	122	0·16
November..	4·48	4·42	3·61	2·28	−0·09	− 69	2135	2·78	2066	2·69	1866	2·43	200	0·26
December...	4·39	4·36	3·56	2·35	+0·11	+ 84	2034	2·65	2118	2·76	1954	2·54	164	0·22
1900														
January.....	244·50	244·63	243·81	242·30	+0·26	+ 200	2022	2·63	2222	2·89	1891	2·46	331	0·43
February....	4·76	4·88	4·05	2·35	+0·28	+ 215	[24]2603	2·69	2278	2·96	1878	2·44	400	0·52
March.......	5·04	5·19	4·34	2·35	+0·46	+ 353	[21]1566	2·04	1919	2·50	1923	2·50	− 4	−0·01
April.......	5·50	5·80	4·91	3·38	+0·40	+ 307	2365	3·08	2672	3·48	1999	2·60	673	0·88
May.........	5·90	5·99	5·09	3·54	+0·05	+ 38	2781	3·62	2819	3·67	2038	2·65	781	1·02
June.........	5·95	5·91	5·02	3·70	−0·09	− 69	2575	3·35	2506	3·26	2056	2·68	450	0·58
July.........	5·86	5·82	4·93	3·64	−0·18	− 138	2520	3·28	2382	3·10	2061	2·68	321	0·42
August......	5·68	5·54	4·67	3·26	−0·35	− 269	2530	3·29	2261	2·94	2034	2·65	227	0·29
September..	5·33	5·12	4·14	3·01	−0·41	− 315	2141	2·79	1826	2·38	1978	2·57	− 152	−0·19
October.....	4·92	4·72	3·85	2·62	−0·28	− 215	2135	2·78	1920	2·50	1893	2·46	27	0·04
November..	4·64	4·55	3·69	2·37	+0·06	+ 46	2151	2·80	2197	2·86	1927	2·51	270	0·35
December...	4·70	4·84	3·96	2·65	+0·06	+ 46	2226	2·90	2272	2·96	1912	2·49	360	0·47
1901														
January.....	4·76	4·68	3·78	2·48	−0·11	− 84	[27]2131	2·77	2047	2·66	1876	2·44	171	0·22
February....	4·65	4·62	3·55	2·13	−0·15	− 115	1898	2·47	1783	2·32	1755	2·28	28	0·04
March.......	4·50	4·39	3·38	1·88	+0·51	+ 392	1893	2·46	2285	2·97	1712	2·23	573	0·75
April........	5·01	5·63	4·35	3·02	+0·76	+ 584	2364	3·08	2948	3·84	1760	2·29	1188	1·55
May.........	5·77	5·91	4·82	3·58	+0·18	+ 138	2442	3·18	2580	3·36	1786	2·32	794	1·04
June.........	5·95	5·99	4·99	3·70	−0·09	− 69	2538	3·30	2469	3·21	1896	2·47	573	0·75
July.........	5·86	5·74	4·81	3·50	−0·28	− 215	2496	3·25	2281	2·97	1936	2·52	345	0·45
August......	5·58	5·42	4·53	3·21	−0·32	− 246	2414	3·14	2168	2·82	1897	2·47	271	0·35
September..	5·26	5·10	4·26	2·97	−0·38	− 292	2305	3·00	2013	2·62	1908	2·48	105	0·14
October.....	4·88	4·65	3·84	2·46	−0·42	− 323	2238	2·91	1915	2·49	1861	2·42	54	0·07
November..	4·46	4·28	3·44	2·00	−0·14	− 108	2152	2·80	2044	2·66	1831	2·38	213	0·28
December...	4·32	4·36	3·54	2·18	+0·07	+ 54	2133	2·78	2187	2·85	1827	2·38	360	0·47

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.

NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at Locks 21, 24 and 27, respectively.

TABLE 27.—Continued.

SUPPLY FACTORS OF LAKE ONTARIO.

Date.	Water Levels of—				Storage in Lake Ontario.		Outflow through St. Lawrence River.		Total Supply to Lake Ontario.		Inflow from Niagara River.		Local Supply to Lake Ontario.	
	Lake Ontario. Oswego, N.Y.		St. Lawrence River.											
	First of Month.	Mean of Month.	Ogdensburg, N.Y. Mean of Month.	Lock 27 Head of Galop Canal, Mean of Month.	Foot Depth.	100 c.f.s.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Feet Depth.	100 c.f.s.	Feet Depth, Lake Ontario.	100 c.f.s.	Foot Depth.
1902														
January.....	4·39	4·42	3·57	1·24	−0·03	− 23	[27]1780	2·32	1757	2·29	1836	2·39	− 79	−0·10
February....	4·36	4·30	3·57	0·24	+0·26	+ 200	[27]1522	1·98	1722	2·24	1706	2·22	16	0·02
March.......	4·62	4·95	4·14	2·44	+0·56	+ 430	[27]2120	2·76	2550	3·32	1739	2·26	811	1·06
April........	5·18	5·40	4·67	3·24	+0·26	+ 200	2227	2·90	2427	3·16	1855	2·41	572	0·74
May.........	5·44	5·47	4·62	3·34	+0·07	+ 54	2411	3·14	2465	3·21	1906	2·48	559	0·73
June.........	5·51	5·55	4·71	3·44	+0·25	+ 192	2434	3·17	2620	3·42	1975	2·57	651	0·85
July.........	5·76	5·97	5·06	3·74	+0·28	+ 215	2590	3·37	2805	3·65	2130	2·77	675	0·88
August......	6·04	6·11	5·12	3·84	−0·16	− 123	2573	3·35	2450	3·19	2110	2·75	340	0·44
September..	5·88	5·66	4·80	3·54	−0·34	− 261	2451	3·19	2190	2·85	2031	2·64	159	0·21
October.....	5·54	5·42	4·51	3·28	−0·30	− 230	2337	3·04	2107	2·74	2053	2·67	54	0·07
November..	5·24	5·05	4·21	3·04	−0·27	− 208	2196	2·86	1988	2·59	1995	2·60	− 7	−0·01
December..	4·97	4·89	4·06	2·74	−0·07	− 54	2265	2·95	2211	2·88	2009	2·61	202	0·26
1903														
January.....	4·90	4·92	3·97	2·54	+0·14	+ 108	[24]1970	2·56	2078	2·70	1961	2·55	117	0·15
February....	5·04	5·16	4·00	2·54	+0·42	+ 323	2049	2·67	2372	3·09	1897	2·47	475	0·62
March.......	5·46	5·75	4·68	3·24	+0·64	+ 492	2236	2·91	2728	3·55	1992	2·59	736	0·96
April........	6·10	6·44	5·48	4·14	+0·40	+ 307	2746	3·57	3053	3·97	2154	2·80	899	1·17
May.........	6·50	6·56	5·60	4·34	0·00	0	2711	3·53	2711	3·53	2159	2·81	552	0·72
June.........	6·50	6·44	5·43	4·14	+0·02	+ 15	2681	3·49	2690	3·51	2184	2·84	512	0·67
July.........	6·52	6·59	5·57	4·24	−0·05	− 31	2769	3·60	2738	3·56	2194	2·86	544	0·71
August......	6·47	6·35	5·35	4·04	−0·26	− 200	2673	3·48	2473	3·22	2110	2·75	363	0·47
September..	6·21	6·07	5·13	3·54	−0·31	− 238	2672	3·48	2434	3·17	2038	2·72	346	0·45
October.....	5·90	5·72	4·70	3·44	−0·36	− 277	2289	2·98	2012	2·62	2045	2·66	− 33	−0·04
November..	5·54	5·36	4·47	3·14	−0·30	−230	2272	2·69	2042	2·66	1966	2·56	76	0·10
December...	5·24	5·11	4·24	3·04	−0·32	− 240	2176	2·83	1930	2·51	1968	2·56	− 38	−0·05
1904														
January.....	4·92	4·72	3·90	2·54	−0·06	− 46	[24]1973	2·57	1927	2·51	1762	2·29	165	0·21
February....	4·86	5·00	4·04	2·54	+0·46	+ 353	1969	2·56	2322	3·02	1813	2·36	509	0·66
March.......	5·32	5·63	4·47	3·04	+1·00	+ 768	2048	2·67	2816	3·67	1931	2·51	885	1·16
April........	6·32	7·00	5·86	4·54	+0·98	+ 753	2369	3·08	3122	4·06	2170	2·82	952	1·24

May.........	7·30	7·61	6·45	5·35	+0·44	+ 338	2675	3·48	3013	3·92	2252	2·93	761	0·99
June.........	7·74	7·87	6·75	5·54	+0·14	+ 108	2888	3·76	2996	3·90	2317	3·02	679	0·88
July.........	7·88	7·89	6·82	5·74	−0·12	− 92	2767	3·60	2675	3·48	2296	2·99	379	0·49
August......	7·76	7·64	6·64	5·38	−0·32	− 246	2904	3·78	2658	3·46	2225	2·90	433	0·56
September..	7·44	7·25	6·22	5·00	−0·38	− 292	2726	3·55	2434	3·17	2157	2·81	277	0·36
October.....	7·06	6·87	5·89	4·65	−0·44	− 338	2640	3·44	2302	3·00	2103	2·74	199	0·26
November..	6·62	6·36	5·36	4·08	−0·54	− 415	2508	3·26	2093	2·72	2033	2·65	60	0·07
December...	6·08	5·81	4·81	3·34	−0·28	− 215	2169	2·82	1954	2·54	1993	2·59	− 39	−0·05
1905														
January.....	245·80	245·79	244·91	243.08	−0·16	− 123	[21]1968	2·56	1845	2·40	1906	2·48	− 61	−0·08
February....	5·64	5·49	4·53	2·78	−0·25	− 192	[21]1779	2·32	1587	2·07	1797	2·34	− 210	−0·27
March.......	5·39	5·29	4·24	2·44	+0·32	+ 246	[21]1886	2·45	2132	2·77	1816	2·36	316	0·41
April........	5·71	6·13	5·09	3·68	+0·48	+ 369	2211	2·88	2580	3·36	1917	2·49	663	0·86
May.........	6·19	6·25	5·28	4·04	+0·23	+ 177	2449	3·19	2626	3·42	2049	2·67	577	0·75
June.........	6·42	6·59	5·64	4·28	+0·36	+ 277	2666	3·47	2943	3·83	2188	2·85	755	0·98
July.........	6·78	6·98	5·95	4·70	+0·16	+ 123	3668	3·47	2791	3·63	2264	2·95	526	0·69
August......	6·94	6·90	5·85	4·44	−0·12	− 92	2778	3·62	2686	3·50	2209	2·87	477	0·62
September..	6·82	6·75	5·76	4·44	−0·22	− 169	2671	3·48	2502	3·26	2161	2·81	341	0·44
October.....	6·60	6·45	5·48	4·28	−0·34	− 261	2475	3·22	2214	2·88	2112	2·75	102	0·13
November..	6·26	6·07	5·24	3·88	−0·28	− 215	2536	3·30	2321	3·02	2029	2·64	292	0·38
December...	5·98	5·88	5·03	3·58	+0·02	+ 15	2220	2·89	2235	2·91	2066	2·69	169	0·22
January.....	6·00	6·13	5·30	3·98	+0·11	+ 84	[21]2403	3·13	2487	3·24	2038	2·65	449	0·58
February....	6·11	6·09	5·11	3·66	−0·11	− 84	2244	2·92	2160	2·81	1936	2·52	224	0·29
March.......	6·00	5·91	4·95	3·51	+0·08	+ 62	2191	2·85	2253	2·93	1889	2·46	364	0·47
April........	6·08	6·25	5·21	3·86	+0·24	+ 184	2518	3·28	2702	3·52	1977	2·57	725	0·94
May.........	6·32	6·38	5·38	4·01	+0·08	+ 62	2589	3·37	2651	3·45	2025	2·64	626	0·81
June.........	6·40	6·41	5·42	4·14	+0·09	+ 69	2527	3·29	2596	3·38	2075	2·70	521	0·68
July.........	6·49	6·57	5·56	4·24	−0·07	− 54	2606	3·39	2552	3·32	2091	2·72	461	0·60
August......	6·42	6·26	5·31	3·96	−0·38	− 292	2551	3·32	2259	2·94	2078	2·70	181	0·24
September..	6·04	5·81	4·92	3·52	−0·40	− 307	2464	3·21	2157	2·81	2025	2·64	132	0·17
October.....	5·64	5·48	4·68	3·42	−0·11	− 84	2283	2·97	2199	2·86	2020	2·63	179	0·23
November..	5·53	5·58	4·62	3·38	+0·13	+ 100	2249	2·93	2349	3·06	2036	2·65	313	0·41
December...	5·66	5·74	4·64	3·29	+0·38	+ 292	2339	3·04	2631	3·04	2066	2·69	565	0·74
1907														
January.....	6·04	6·34	5·20	3·35	+0·36	+ 277	[21]2266	2·95	2543	3·31	2185	2·84	358	0·47
February....	6·40	6·46	5·42	3·47	+0·06	+ 46	[21]2207	2·87	2253	2·93	2070	2·69	183	0·24
March.......	6·46	6·47	5·32	3·63	+0·20	+ 154	[21]2291	2·98	2445	3·18	2014	2·62	431	0·56
April........	6·66	6·85	5·74	4·42	+0·30	+ 230	2664	3·47	2894	3·77	2105	2·74	789	1·03
May.........	6·96	7·08	6·03	4·73	+0·14	+ 108	2741	3·57	2849	3·71	2157	2·81	692	0·90
June.........	7.10	7·11	6·05	4·78	+0·02	+ 15	2720	3·54	2735	3·56	2239	2·91	496	0·65
July.........	7·12	7·12	6·12	4·85	−0·11	− 84	2742	3·57	2658	3·46	2276	2·96	382	0·50
August......	7·01	6·90	5·90	4·63	−0·31	− 238	2672	3·48	2434	3·17	2200	2·86	234	0·30
September..	6·70	6·50	5·51	4·19	−0·21	− 161	2590	3·37	2429	3·16	2148	2·80	281	0·37
October.....	6·49	6·48	5·42	4·16	−0·09	− 69	2509	3·27	2440	3·18	2145	2·79	295	0·38
November..	6·40	6·33	5·31	4·06	−0·07	− 54	2467	3·21	2413	3·14	2126	2·77	287	0·37
December...	6·33	6·33	5·34	3·93			2284	2·97			2108	2·74		

a.—Niagara River discharge values include a flow of 1000 c.f.s. through Erie Canal and 1100 c.f.s. through Welland Canal.
NOTE.—21, 24 and 27 indicate that St. Lawrence River discharges were derived from gauge observations taken at locks 21, 24 and 27, respectively.

TABLE 28.

MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES, 1860-1907, INCLUSIVE.

Supply Factors.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec
LAKE SUPERIOR.												
Stage, in feet above mean sea level	602·03	601·85	601·77	601·86	602·16	602·42	602·63	602·73	602·79	602·74	602·56	602·26
Storage, in 100 c. f. s.	−718	−409	− 13	+650	+959	+809	+525	+267	+ 6	−385	−803	−911
Outflow, in 100 c. f. s.	741	701	680	703	798	857	908	927	928	913	875	804
Total supply, in 100 c. f. s.	23	292	668	1353	1757	1666	1433	1193	934	528	73	−107
Local supply, in 100 c. f. s.	23	292	668	1353	1757	1666	1433	1193	934	528	73	−107
LAKE MICHIGAN-HURON.—*a*												
Stage, in feet above mean sea level	580·93	580·93	581·05	581·25	581·55	581·79	581·90	581·86	581·67	581·45	581·21	580·99
Storage, in 100 c. f. s.	−265	+286	+792	+1222	+1323	+864	+150	−571	−987	−1122	−1120	−794
Outflow, in 100 c. f. s.—*b*.	1919	1763	1873	2003	2053	2155	2202	2204	2163	2117	2082	2052
Total supply, in 100 c. f. s.	1654	2049	2664	3225	3377	3019	2352	1633	1176	995	962	1258
Local supply, in 100 c. f. s.	913	1347	1984	2522	2578	2162	1442	706	247	82	87	453
LAKE ERIE.												
Stage, in feet above mean sea level	572·10	572·03	572·22	572·70	573·05	573·24	573·22	573·04	572·78	572·45	572·21	572·14
Storage, in 100 c. f. s.	− 68	+ 59	+366	+441	+276	+ 90	−108	−232	−311	−303	−165	− 64
Outflow, in 100 c. f. s.—*c*.	2044	1981	2012	2116	2192	2251	2263	2203	2152	2095	2063	2085
Total supply, in 100 c. f. s.	1976	2040	2378	2557	2469	2340	2154	1971	1841	1792	1898	2020
Local supply, in 100 c. f. s.	+ 64	+284	+513	+561	+422	+192	− 41	−227	−316	−318	−177	− 24
LAKE ONTARIO.												
Stage, in feet above mean sea level	245·58	245·65	245·91	246·49	246·82	246·95	246·93	246·63	246·22	245·88	245·63	245·57
Storage, in 100 c. f. s.	+ 28	+127	+323	+348	+179	+ 44	−124	−273	−287	−226	−120	− 24
Outflow, in 100 c. f. s.	2228	2193	2333	2606	2795	2835	2836	2750	2621	2526	2450	2341
Total supply, in 100 c. f. s.	2255	2320	2656	2954	2975	2880	2712	2477	2334	2300	2329	2318
Local supply, in 100 c. f. s.	211	340	644	838	782	629	449	274	182	206	266	228

a—Lake St. Clair included as part of Lake Michigan-Huron Watershed.
b—This quantity includes the flow through the Chicago Drainage Canal since 1900.
c—This quantity includes a flow of 1000 c. f. s. through the Erie Canal, and 1100 c. f. s. through the Welland Canal.

TABLE 31.

MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES.

EXPRESSED IN CUBIC FEET PER SECOND PER SQUARE MILE OF WATERSHED, 1860-1907, INCLUSIVE.

Supply Factors.	Jan.	Feb.	Mar.	Apr.	May.	June.	July.	Aug.	Sept.	Oct.	Nov.	Dec.
LAKE SUPERIOR.												
Storage, c. f. s. per square mile....	−0·94	−0·54	−0·02	+0·85	+1·26	+1·06	+0·69	+0·35	+0·01	−0·51	−1·06	−1·20
Outflow, c. f. s. per square mile...	0·97	0·92	0·89	0·92	1·05	1·13	1·19	1·22	1·22	1·20	1·15	1·06
Total supply, c. f. s. per square mile	0·03	0·38	0·88	1·78	2·31	2·19	1·88	1·57	1·23	0·69	0·10	−0·14
Local supply, c.f.s. per square mile	0·03	0·38	0·88	1·78	2·31	2·19	1·88	1·57	1·23	0·69	0·10	−0·14
LAKE MICHIGAN-HURON—a												
Storage, c.f.s. per square mile....	−0·12	+0·13	+0·36	+0·56	+0·60	+0·39	+0·07	−0·26	−0·45	−0·51	−0·51	−0·36
Outflow, c.f.s. per square mile.—b.	0·87	0·80	0·85	0·91	0·93	0·98	1·00	1·00	0·98	0·96	0·95	0·93
Total supply, c.f.s. per square mile	0·75	0·93	1·21	1·46	1·53	1·37	1·07	0·74	0·53	0·45	0·44	0·57
Local supply, c.f.s. per square mile	0·63	0·94	1·38	1·75	1·79	1·50	1·00	0·49	0·17	0·06	0·06	0·32
LAKE ERIE.												
Storage, c.f.s. per square mile....	−0·03	+0·02	+0·14	+0·17	+0·11	+0·04	−0·04	−0·09	−0·12	−0·12	−0·06	−0·02
Outflow, c.f.s. per square mile.—c.	0·80	0·78	0·79	0·83	0·86	0·88	0·89	0·86	0·84	0·82	0·81	0·82
Total supply, c.f.s. per square mile	0·78	0·80	0·93	1·00	0·97	0·92	0·85	0·77	0·72	0·70	0·74	0·79
Local supply, c.f.s. per square mile	+0·18	+0·82	+1·48	+1·62	+1·22	+0·56	−0·12	−0·66	−0·91	−0·92	−0·51	−0·07
LAKE ONTARIO.												
Storage, c.f.s. per square mile.....	+0·01	+0·04	+0·11	+0·12	+0·06	+0·02	−0·04	−0·10	−0·10	−0·08	−0·04	−0·01
Outflow, c.f.s. per square mile....	0·77	0·76	0·81	0·91	0·97	0·98	0·99	0·96	0·91	0·88	0·85	0·81
Total supply, c.f.s. per square mile	0·78	0·81	0·92	1·03	1·03	1·00	0·94	0·86	0·81	0·80	0·81	0·81
Local supply, c.f.s. per square mile	0·64	1·03	1·95	2·54	2·37	1·91	1·36	0·83	0·55	0·62	0·81	0·69

a—Lake St. Clair included as part of Lake Michigan-Huron Watershed.
b—This quantity includes the flow through the Chicago Drainage Canal since 1900.
c—This quantity includes the flow through the Erie Canal and through the Welland Canal.

TABLE 33.

REGULATION OF LAKE ERIE

Date.	Water Levels of Lake Erie.				Storage in Lake Erie.		Outflow Through Niagara River, 100 c.f.s. [a]	Total Supply to Lake Erie, 100 c.f.s. [a]	Expected Change in total Supply over Preceding Month, 100 c.f.s.	Expected Total Supply for Month, 100 c.f.s.	Regulated Lake Level Desired, Buffalo, N.Y., First of Month.	Expected total Supply minus Total Supply, 100 c.f.s.
	Cleveland, O.		Buffalo, N.Y.									
	First of Month.	Mean of Month.	First of Month.	Mean of Month.	Foot Depth.	100 c.f.s.						
1890												
January....	572·20	572·38	572·64	572·93	+0·32	+338	2157	2495	−44	2304	−191	573·8
February...	2·52	2·67	2·84	2·74	+0·21	+222	2112	2334	+ 64	2559	+225	3·7
March......	2·73	2·79	2·86	2·98	+0·31	+328	2170	2498	+338	2672	+174	3·7
April.......	3·04	3·28	3·10	3·23	+0·41	+434	2230	2664	+179	2677	+ 13	3·8
May........	3·45	3·62	3·41	3·59	+0·35	+370	2321	2691	− 88	2576	−115	3·9
June........	3·80	3·99	3·76	3·92	0·00	0	2405	2405	−129	2562	+157	4·0
July........	3·80	3·61	3·78	3·64	−0·42	−444	2333	1889	−186	2219	+330	4·0
August.....	3·38	3·15	3·40	3·17	−0·32	−338	2216	1878	−183	1706	−172	4·0
September.	3·06	2·98	3·00	2·82	−0·18	−190	2131	1941	−130	1748	−193	4·0
October....	2·88	2·79	2·82	2·81	−0·10	−106	2129	2023	− 49	1892	−131	4·0
November.	2·78	2·76	2·90	3·00	−0·14	−148	2175	2027	+106	2129	+102	4·0
December..	2·64	2·53	2·87	2·74	−0·22	−233	2112	1879	+122	2149	+270	3·9
1891												
January....	2·42	2·31	2·61	2·48	−0·12	−127	2051	1924	− 44	1835	− 89	3·8
February...	2·30	2·29	2·42	2·36	+0·22	+233	2025	2258	+ 64	1988	−270	3·7
March......	2·52	2·75	2·43	2·50	+0·16	+169	2056	2225	+338	2596	+371	3·7
April.......	2·68	2·62	2·56	2·62	−0·15	−159	2085	1926	+179	2404	+478	3·8
May........	2·53	2·44	2·51	2·40	−0·02	− 21	2033	2012	− 88	1838	−174	3·9
June........	2·51	2·58	2·39	2·38	+0·02	+ 21	2029	2050	−129	1883	−167	4·0
July........	2·53	2·48	2·47	2·56	−0·19	−201	2070	1869	−186	1864	− 5	4·0
August.....	2·34	2·21	2·42	2·27	−0·22	−233	2004	1771	−183	1686	− 85	4·0
September.	2·12	2·03	2·18	2·10	−0·28	−296	1965	1669	−130	1641	− 28	4·0
October....	1·84	1·65	1·92	1·73	−0·41	−434	1882	1448	− 49	1620	+172	4·0
November.	1·43	1·21	1·70	1·67	−0·19	−201	1870	1669	+106	1554	−115	4·0
December..	1·24	1·28	1·68	1·70	+0·06	+ 63	1876	1939	+122	1791	−148	3·9
1892												
January....	1·30	1·31	1·66	1·61	−0·10	−106	1857	1751	− 44	1895	+144	3·8
February...	1·20	1·10	1·26	0·92	−0·08	− 85	1712	1627	+ 64	1815	+188	3·7
March......	1·12	1·14	1·02	1·12	+0·30	+317	1754	2071	+338	1965	−106	3·7
April.......	1·42	1·70	1·54	1·96	+0·68	+719	1933	2652	+179	2250	−402	3·8
May........	2·10	2·50	2·18	2·40	+0·78	+825	2033	2858	− 88	2564	−294	3·9
June........	2·88	3·26	2·80	3·21	+0·44	+465	2225	2690	−129	2729	+ 39	4·0
July........	573·32	573·38	573·32	573·42	−0·12	−127	2278	2151	−186	2504	+353	574·0
August.....	3·20	3·03	3·24	3·05	−0·33	−349	2187	1838	−183	1968	+130	4·0
September.	2·87	2·71	2·92	2·78	−0·44	−465	2122	1657	−130	1708	+ 51	4·0
October....	2·43	2·15	2·62	2·45	−0·45	−476	2045	1569	− 49	1608	+ 39	4·0
November.	1·98	1·82	2·26	2·07	−0·30	−317	1957	1640	+106	1675	+ 35	4·0
December..	1·68	1·55	2·06	2·04	−0·32	−338	1952	1614	+122	1762	+148	3·9
1893												
January....	1·36	1·17	1·66	1·27	−0·15	−159	1785	1626	− 44	1570	− 56	3·8
February...	1·21	1·25	1·24	1·22	+0·15	+159	1775	1934	+ 64	1690	−244	3·7
March......	1·36	1·47	1·38	1·53	+0·48	+508	1840	2348	+338	2272	− 76	3·7
April.......	1·84	2·20	1·86	2·19	+0·78	+825	1985	2810	+179	2527	−283	3·8
May.... ..	2·62	3·04	2·55	2·91	+0·52	+550	2153	2703	− 88	2722	+ 19	3·9
June........	3·14	3·23	3·08	3·26	−0·05	− 53	2237	2184	−129	2574	+390	4·0
July........	3·09	2·95	3·20	3·13	−0·31	−328	2203	1875	−186	1998	+123	4·0
August.....	2·78	2·61	2·84	2·54	−0·36	−381	2065	1684	−183	1692	+ 8	4·0
September	2·42	2·23	2·42	2·29	−0·36	−381	2007	1626	−130	1554	− 72	4·0
October....	2·06	1·88	2·24	2·19	−0·38	+402	1985	1583	− 49	1577	− 6	4·0
November.	1·68	1·48	2·18	2·17	−0·16	+169	1980	1811	+106	1689	−122	4·0
December..	1·52	1·56	2·15	2·13	+0·18	+190	1972	2162	+122	1933	−229	3·9

a.—The flow of 1,000 c.f.s. through the Erie Canal, and that of 1,100 c.f.s. through the Welland Canal have been omitted.

BETWEEN STAGES 573·7 AND 574·7.

Change in Stage required by last of Month, Foot Depth.	Change in Outflow to give Change in Preceding Column 100 c.f.s.	Expected Regulated Outflow for Month, 100 c.f.s.	Regulated Outflow for First of Month, 100 c.f.s.	REGULATED STORAGE IN LAKE ERIE.		Regulated Lake Level, Buffalo, N.Y., Mean of Month.	Regulated Level minus regulated level desired, First of Month.	REGULATED LAKE LEVEL MINUS ACTUAL LAKE LEVEL, BUFFALO, N.Y.		Regulated Lake Level, Buffalo, N.Y., First of Month.	Sluice Gates.
				100 c.f.s.	Foot Depth.			First of Month.	Mean of Month.		
−0.10	+106	2410	2374	+121	+0.10	573.80	+0.00	1.16	1.11	574.04	Open January
−0.20	+211	2770	2400	− 66	−0.06	3.90	+0.20	1.06	1.02	3.76	Open February
−0.04	+ 42	2714	2384	+114	+0.10	3.84	+0.14	0.98	0.91	3.89	Open March
−0.04	+ 42	2719	2410	+254	+0.21	3.94	+0.14	0.84	0.79	4.02	Open April
−0.15	+159	2735	2466	+225	+0.19	4.15	+0.25	0.74	0.66	4.25	Open May
−0.34	+360	2922	2516	−111	−0.09	4.34	+0.34	0.58	0.52	4.44	Open June
−0.25	+264	2483	2483	−594	−0.50	4·25	+0.25	0.47	0.41	4.05	Part July
+0.25	−264	1442	1667	+211	+0.20	3.75	−0.25	0.35	0.65	3.82	Min. August
+0.05	− 53	1695	1695	+246	+0.21	3.95	−0.05	0.95	1.14	3.96	Part September
−0.16	+169	2016	2016	− 38	−0.03	4.16	+0.16	1.34	1.28	4.09	Part October
−0.23	+243	2372	2372	−345	−0.29	4.13	+0.13	1.23	1.10	4.10	Part November
−0.04	+ 42	2191	2191	−312	−0.26	3.84	−0.06	0.97	0.97	3.71	Part December
+0.12	−127	1708	1708	+216	+0.18	3.58	−0.22	0·97	1.16	3.64	Part January
−0.06	−127	2051	2051	+207	+0.17	3.76	+0.06	1.34	1.42	3.78	Part February
−0.13	+137	2733	2408	−183	−0.15	3.93	+0.23	1.50	1.36	3.86	Open March
+0.12	−127	2277	2277	−361	−0.30	3.78	−0.02	1.22	1.10	3.72	Part April
+0.52	−550	1288	1667	+345	+0.33	3.48	−0.42	0.97	1.20	3.60	Min. May
+0.19	−201	1682	1682	+368	+0.31	3.81	−0.19	1.42	1.54	3.92	Part June
−0.12	+127	1991	1991	−122	−0.10	4.12	+0.12	1.65	1.62	4.18	Part July
+0.02	+ 21	1707	1707	+ 64	+0.05	4.02	+0.02	1.60	1.74	4.01	Part August
−0.07	+ 74	1715	1715	− 46	−0.04	4.07	+0.07	1.89	2.00	4.10	Part September.
−0.03	+ 32	1652	1667	−219	−0.21	4.03	+0.03	2.11	2.12	3.85	Min. October
+0.08	− 85	1469	1667	+ 2	0.00	3.82	−0.18	2.12	2.13	3.80	Min. November
−0.02	− 21	1812	1812	+127	+0.11	3.82	−0.08	2.14	2.20	3.90	Part December
−0.23	+243	2138	2138	−387	−0.32	3.93	+0.13	2.27	2.31	3.92	Part January
+0.09	− 95	1720	1720	− 93	−0.08	3.61	−0.09	2.35	2.43	3.35	Part February
+0.27	−286	1679	1679	+392	+0.33	3.53	−0.17	2.51	2.42	3.54	Part March
+0.04	− 42	2208	2208	+444	+0.37	3.86	+0.06	2.32	2.18	4.14	Part April
+0.23	+243	2807	2487	+371	+0.31	4.23	+0.33	2.05	1.90	4.30	Open May
−0.54	+571	3300	2571	+119	+0.10	4.54	+0.54	1.74	1.53	4.74	Open June
−0.64	+677	3181	2598	−447	−0.38	574.64	0.64	1.32	1.17	574.59	Open July
−0.26	+275	2243	2243	−405	−0.34	4.26	+0.26	1.02	1.01	4.06	Part August
+0.08	− 85	1623	1667	− 10	−0.01	3.92	−0.08	1.00	1.14	3.92	Min. September
+0.09	− 95	1513	1667	− 98	−0.09	3.91	−0.09	1.29	1.42	3.87	Min. October
+0.08	− 85	1590	1667	− 27	−0.03	3.82	−0.18	1.56	1.64	3.71	Min. November
+0.01	− 11	1751	1751	−137	−0.12	3.79	−0.11	1.73	1.87	3.91	Part December
+0.03	− 32	1538	1667	− 41	−0.04	3.67	−0.13	3.01	2.20	3.47	Min. January
+0.07	− 74	1616	1667	+267	−0.25	3.63	−0.07	2.39	2.44	3.66	Min. February
−0.08	+ 85	2357	2357	− 29	−0.01	3.88	+0.18	2.50	2.26	3.79	Part March
+0.03	− 32	2495	2392	+418	+0.35	3.87	+0.07	2.01	1.84	4.03	Open April
+0.22	+233	2955	2484	+219	+0.18	4.22	+0.32	1.67	1.50	4.41	Open Mau
−0.40	+423	2997	2532	−348	−0.29	4.40	+0.40	1.32	1.12	4.38	Open June
−0.11	+116	2114	2114	−239	−0.20	4.11	−0.11	0.91	0.99	4.12	Part July
+0.09	− 95	1597	1667	+ 17	+0.02	3.91	−0.09	1.07	1.29	3.83	Min. August
+0.07	− 74	1480	1667	− 41	−0.04	3.93	−0.07	1.51	1.58	3.87	Min. September
+0.11	−116	1461	1667	− 84	−0.08	3.89	−0.11	1.65	1.64	3.83	Min. October
+0.09	− 95	1594	1667	+144	+0.14	3.81	−0.19	1.63	1.72	3.89	Min. November
−0.15	−159	2092	2092	+ 70	+0.06	3.95	+0.05	1.80	1.84	3.97	Part December

TABLE 33. REGULATION OF LAKE ERIE

Date.	Water Levels of Lake Erie.				Storage in Lake Erie.		Outflow Through Niagara River, 100 c.f.s. a	Total Supply to Lake Erie, 100 c.f.s. a	Expected Change in total Supply over Preceding Month, 100 c.f.s.	Expected Total Supply for Month, 100 c.f.s.	Regulated Lake Level Desired, Buffalo, N.Y., First of Month.	Expected total Supply minus Total Supply, 100 c.f.s.
	Cleveland, O.		Buffalo, N.Y.									
	First of Month.	Mean of Month.	First of Month.	Mean of Month.	Foot Depth.	100 c.f.s.						
1894												
January....	1·70	1·84	2·13	2·13	+0·08	+ 85	1972	2057	− 44	2118	+ 61	3·0
February...	1·78	1·72	1·94	1·75	−0·04	− 42	1887	1845	+ 64	2121	+276	3·7
March... ..	1·74	1·75	1·80	1·86	+0·21	+222	1910	2132	+338	2183	+ 51	3·7
April..	1·95	2·15	1·96	2·05	+0·39	+412	1953	2365	+179	2311	− 54	3·8
May........	2·34	2·54	2·30	2·55	+0·30	+317	2067	2384	− 88	2277	−107	3·9
June........	2·64	2·75	2·74	2·94	+0·10	+106	2160	2266	−129	2255	− 11	4·0
July...	2·74	2·73	2·88	2·81	−0·20	−211	2129	1918	−186	2080	−162	4·0
August.....	2·54	2·36	2·58	2·34	−0·26	−275	2019	1744	−183	1735	− 9	4·0
September.	2·28	2·19	2·26	2·17	−0·25	−264	1981	1717	−130	1614	−103	4·0
October....	2·03	1·87	2·17	2·17	−0·28	−296	1981	1685	− 49	1668	− 17	4·0
November.	1·75	1·63	2·08	1·99	−0·15	−159	1941	1782	+106	1791	+ 9	4·0
December..	1·60	1·56	1·90	1·82	−0·20	−211	1902	1691	+122	1904	+213	3·9
1895												
January....	1·40	1·23	1·76	1·69	−0·28	−296	1875	1579	− 44	1647	+ 68	3·8
February...	1·12	1·00	1·34	1·00	−0·12	−127	1728	1601	− 64	1643	+ 42	3·7
March......	1·00	1·01	0·96	0·92	+0·14	+148	1712	1860	+338	1939	+ 79	3·7
April.......	1·14	1·26	1·02	1·13	+0·23	+243	1756	1999	+179	2039	+ 40	3·8
May........	1·37	1·48	1·30	1·48	+0·15	+159	1829	1988	− 88	1911	− 77	3·9
June........	1·52	1·57	1·53	1·58	0·00	0	1851	1851	−129	1859	+ 8	4·0
July........	1·52	1·46	1·57	1·56	−0·10	−106	1846	1740	−186	1665	− 75	4·0
August.....	1·42	1·38	1·49	1·42	−0·09	− 95	1817	1722	−183	1557	−165	4·0
September.	1·33	1·28	1·43	1·44	−0·29	−307	1821	1514	−130	1592	+ 78	4·0
October....	1·04	0·80	1·32	1·20	−0·29	−307	1771	1464	− 49	1465	+ 1	4·0
November.	0·75	0·70	0·96	0·71	+0·03	+ 32	1670	1702	+106	1570	−132	4·0
December..	0·78	0·86	0·84	0·97	+0·13	+137	1723	1860	+122	1824	− 36	3·9
1896												
January...	0·91	0·96	1·04	1·12	+0·01	+ 11	1754	1765	− 44	1816	+ 51	3·8
February...	0·92	0·88	1·08	1·05	−0·06	− 63	1739	1676	+ 64	1829	+153	3·7
March......	0·86	0·83	0·87	0·69	+0·20	+211	1666	1877	+338	2014	+137	3·7
April.......	1·06	1·28	0·96	1·22	+0·41	+434	1775	2209	+179	2056	−153	3·8
May........	1·47	1·66	1·44	1·67	+0·33	+349	1870	2219	− 88	2121	− 98	3·9
June........	1·80	1·93	1·68	1·68	+0·07	+ 74	1872	1946	−129	2090	+144	4·0
July........	1·87	1·81	1·77	1·86	+0·05	+ 53	1911	1964	−186	1760	−204	4·0
August.....	1·92	2·02	1·98	2·09	−0·06	− 63	1962	1899	−183	1781	−118	4·0
September.	1·86	1·70	1·88	1·67	−0·28	−296	1870	1574	−130	1769	+195	4·0
October....	1·58	1·56	1·54	1·41	−0·30	−317	1815	1498	− 49	1525	+ 27	4·0
November.	1·28	1·09	1·42	1·44	−0·18	−190	1821	1631	+106	1604	− 27	4·0
December..	1·10	1·12	1·34	1·23	0·00	0	1776	1776	+122	1752	− 23	3·9
1897												
January....	1·10	1·09	1·41	1·59	+0·09	+ 95	1854	1949	− 44	1732	−217	3·8
February...	1·19	1·29	1·37	1·15	+0·29	+307	1760	2067	+ 64	2013	− 54	3·7
March......	1·48	1·66	1·40	1·66	+0·46	+486	1867	2352	+338	2405	+ 52	3·7
April.......	1·94	2·21	1·92	2·18	+0·44	+465	1983	2448	+179	2532	+ 84	3·8
May........	2·38	2·54	2·39	2·60	+0·21	+222	2080	2302	− 88	2360	+ 58	3·9
June........	2·59	2·64	2·60	2·59	+0·05	+ 53	2076	2129	−129	2173	+ 44	4·0
July........	2·64	2·63	2·58	2·57	−0·09	− 95	2072	1977	−186	1943	− 34	4·0
August.....	2·55	2·47	2·51	2·45	−0·22	−233	2045	1812	−183	1794	− 18	4·0
September.	2·33	2·19	2·27	2·09	−0·39	−412	1963	1551	−130	1682	+131	4·0
October....	1·94	1·70	1·87	1·65	−0·30	−317	1865	1548	− 49	1502	− 46	4·0
November.	1·64	1·57	1·67	1·69	−0·08	− 85	1874	1789	+106	1654	−135	4·0
December..	1·56	1·54	1·75	1·81	0·00	0	1900	1900	+122	1911	+ 11	3·9

a.—The flow of 1000 c. f. s. through the Erie Canal and that of 1100 c. f. s. through the Welland Canal have been omitted.

BETWEEN STAGES 573·7 AND 574·7.

Change in Stage required by last of Month Foot Depth.	Change in Outflow to give Change in Preceding Column 100 c.f.s.	Expected Regulated Outflow for Month, 100 c.f.s.	Regulated Outflow for First of Month. 100 c.f.s.	Regulated Storage in Lake Erie.		Regulated Lake Level, Buffalo, N.Y., First of Month.	Regulated Level minus regulated level desired, First of Month.	Regulated Lake Level minus actual Lake Level, Buffalo, N.Y.		Regulated Lake Level, Buffalo, N.Y., Mean of Month.	Sluice Gates.
				100 c.f.s.	Foot Depth.			First of Month.	Mean of Month.		
−0.31	+ 328	2446	2429	−372	−0.31	4.01	+0.21	1.88	1.82	3.95	Open January
0.00	0	2121	2121	−276	−0.23	3.70	0.00	1.76	1.72	3.47	Part February
+0.33	− 349	1834	1834	+298	+0.25	3.47	−0.23	1.67	1.72	3.58	Part March
+0.18	− 190	2121	2121	+244	+0.21	3.72	−0.08	1.76	1.70	3.75	Part April
+0.07	− 74	2203	2203	+181	+0.15	3·93	+0.03	1.63	1.48	4.03	Part May
−0.08	+ 85	2340	2340	− 74	−0.06	4.08	+0.08	1.34	1.24	4.18	Part June
−0.02	+ 21	2101	2101	−183	−0.15	4.02	+0.02	1.14	1.22	4.03	Part July
+0.13	− 137	1598	1667	+ 77	−0.07	3.87	−0.13	1.29	1.48	3.82	Min. August
+0.06	− 63	1551	1667	+ 50	+0.05	3.94	−0.06	1.68	1.75	3.92	Min. September
+0.01	− 11	1657	1667	+ 18	+0.02	3.99	−0.01	1.82	1.88	4.05	Min. October
−0.11	+ 116	1907	1907	−125	−0.11	4.01	+0.01	1.93	1.96	3.95	Part November
−0.10	+ 106	2010	2010	−319	−0.27	3.90	0.00	2.00	1.94	3.76	Part December
+0·07	− 74	1573	1667	− 88	−0·08	3·63	−0·17	1·87	2·04	3·73	Min. January
+0·15	− 159	1484	1667	− 66	−0·06	3·55	−0·15	2·21	2·37	3·37	Min. February
+0·31	− 328	1611	1667	+193	+0·18	3·49	−0·21	2·53	2·59	3·51	Min. March
+0·23	− 243	1796	1796	+203	+0·17	3·67	−0·13	2·65	2·60	3·73	Part April
+0·16	− 169	1742	1742	+246	+0·21	3·84	−0·06	2·54	2·53	4·01	Part May
−0·05	+ 53	1912	1912	− 61	−0·05	4·05	+0·05	2·52	2·48	4·06	Part June
0·00	0	1665	1667	+ 73	+0·07	4·00	0·00	2·43	2·50	4·06	Min. July
−0·07	+ 74	1631	1667	+ 55	+0·05	4·07	+0·07	2·58	2·64	4·06	Min. August
−0·12	+ 127	1719	1719	−205	−0·17	4·12	−0·12	2·69	2·66	4·10	Part September
+0·05	− 53	1412	1667	−203	−0·19	3·95	+0·05	2·63	2·72	3·92	Min October
+0·14	− 148	1422	1667	+ 35	+0·03	3·76	−0·24	2·80	2·88	3·59	Min. November
+0·01	− 11	1813	1813	+ 47	+0·04	3·79	−0 11	2·95	2·87	3·84	Part December
−0·13	+ 137	1953	1953	−188	−0·16	3·83	+0·03	2·79	2·69	3·81	Part January
+0·03	− 32	1797	1797	−121	−0·10	3·67	−0·03	2·59	2·64	3·69	Part February
+0·23	− 243	1771	1171	+106	−0·09	3·57	−0·13	2·70	2·70	3·39	Part March
+0·24	− 254	1802	1802	+407	+0·34	3·66	−0·14	2·70	2·63	3·85	Part April
0·00	0	2121	2121	+ 98	+0·08	4·00	+0·10	2·56	2·48	4·15	Part May
−0·08	+ 85	2175	2175	−229	−0·19	4·08	+0·08	2·40	2·26	3·94	Part June
+0·11	− 116	1644	1667	+297	+0·28	4·89	−0·11	2·12	2·16	4·02	Min. July
−0·17	+ 180	1961	1961	− 62	−0·05	3·17	+0·17	2·19	2·22	4·31	Part August
−0·12	+ 127	1896	1896	−322	−0·27	4·12	+0·12	2·24	2·28	3·95	Part September
+0·15	− 159	1366	1667	−169	−0·16	3·85	−0·15	2·31	2·29	3·70	Min. October
+0·21	− 222	1382	1667	− 36	−0·03	3·69	−0·31	2·27	2·30	3·74	Min. November
+0·14	− 148	1605	1667	+109	+1·10	3·36	−0·24	2·32	2·34	3·57	Min. December
−0·06	+ 63	1795	1795	+154	+0·13	3·76	−0·04	2·35	2·44	4·03	Part January
−0·19	+ 201	2214	2214	−147	−0·12	3·89	+0·19	2·52	2·44	3·59	Part February
+0·03	− 32	2373	2366	− 13	−0·01	3·77	+0·07	2·37	2·10	3·76	Open March
+0·14	− 148	2384	2364	− 84	+0·07	3·76	−0·04	1·84	1·64	3·82	Open April
+0·17	− 180	2180	2180	+122	+0·10	3·83	−0·07	1·44	1·38	3·98	Part May
+0·07	− 74	2099	2099	+ 30	+0·03	3·93	−0·07	1·33	1·36	3·95	Part June
+0·04	− 42	1901	1901	+ 76	+0·06	3·96	−0·04	1·38	1·44	4·01	Part July
−0·02	+ 21	1815	1815	− 3	0·00	4·02	+0·02	1·51	1·63	4·08	Part August
−0·02	+ 21	1703	1703	−152	−0·13	4·02	+0·12	1·75	1·88	3·97	Part September
+0·11	− 116	1386	1667	−119	−0·11	3·89	−0·11	2·02	2·06	3·71	Min. October
+0·12	− 127	1527	1667	+122	+0·12	3·78	−0·22	2·11	2·13	3·82	Min. November
−0·10	+ 106	2017	2017	−117	−0·10	3·90	0·00	2·15	2·10	3·91	Part December

TABLE 33. REGULATION OF LAKE ERIE

Date.	WATER LEVELS OF LAKE ERIE.				STORAGE IN LAKE ERIE.		Outflow Through Niagara River, 100 c.f.s. *a*	Total Supply to Lake Erie, 100 c.f.s. *a*	Expected Change in total Supply over Preceding Month, 100 c.f.s.	Expected Total Supply for Month, 100 c.f.s.	Expected total Supply minus Total Supply, 100 c.f.s.	Regulated Lake Level Desired, Buffalo, N.Y., First of Month.
	Cleveland, O.		Buffalo, N.Y.									
	First of Month.	Mean of Month.	First of Month.	Mean of Month.	Foot Depth.	100 c.f.s.						
1898												
January....	1·56	1·59	1·74	1·68	+0·13	+137	1872	2009	− 44	1856	−153	3·8
February...	1·69	1·79	1·62	1·57	+0·23	+243	1849	2092	+ 64	2073	− 19	3·7
March......	1·92	2·05	1·76	1·95	+0·42	+444	1930	2374	+338	2430	+ 56	3·7
April.......	2·34	2·63	2·25	2·55	+0·36	+381	2067	2448	+179	2553	+105	3·8
May........	2·70	2·78	2·62	2·68	+0·10	+106	2098	2204	− 88	2360	+156	3·9
June........	2·80	2·81	2·70	2·72	−0·10	−106	2107	2001	−129	2075	+ 74	4·0
July........	572·70	572·59	572·61	572·50	−0·21	−222	2056	1834	−186	1815	− 19	574·0
August.....	2·49	2·39	2·48	2·46	−0·29	−307	2047	1740	−183	1651	− 89	4·0
September.	2·20	2·01	2·27	2·08	−0·29	−307	1960	1653	−130	1610	− 43	4·0
October....	1·91	1·81	2·00	1·91	−0·16	−169	1922	1753	− 49	1604	−149	4·0
November.	1·75	1·69	1·96	2·01	−0·15	−159	1944	1785	+106	1859	+ 26	4·0
December..	1·60	1·52	2·04	2·07	0·00	0	1957	1957	+122	1907	− 50	3·9
1899												
January....	1·60	1·67	2·06	2·05	−0·04	− 42	1953	1911	− 44	1913	+ 2	3·8
February...	1·56	1·46	1·82	1·59	+0·08	+ 85	1854	1939	+ 64	1975	+ 36	3·7
March......	1·64	1·83	1·72	1·85	+0·34	+360	1908	2268	+338	2277	+ 9	3·7
April.......	1·98	2·13	1·94	2·04	+0·30	+317	1952	2269	+179	2447	+178	3·8
May........	2·28	2·44	2·18	2·32	+0·22	+233	2015	2248	− 88	2181	− 67	3·9
June........	2·50	2·56	2·42	2·51	−0·08	− 85	2058	1973	−129	2119	+146	4·0
July........	2·42	2·28	2·48	2·45	−0·24	−254	2045	1791	−186	1787	− 4	4·0
August.....	2·18	2·09	2·27	2·09	−0·21	−222	1962	1740	−183	1608	−132	4·0
September.	1·97	1·85	2·00	1·90	−0·24	−254	1920	1666	−130	1610	− 56	4·0
October....	1·73	1·61	1·69	1·48	−0·11	−116	1829	1713	− 49	1617	− 96	4·0
November.	1·62	1·62	1·52	1·55	−0·14	−148	1845	1697	+106	1819	+122	4·0
December..	1·48	1·34	1·76	1·96	−0·13	−137	1933	1796	+122	1819	+ 23	3·9
1900												
January....	1·35	1·36	1·82	1·67	+0·11	+116	1870	1986	− 44	1752	−234	3·8
February...	1·46	1·57	1·64	1·61	+0·28	+296	1857	2153	+ 64	2050	−103	3·7
March......	1·74	1·92	1·72	1·82	+0·34	+360	1902	2262	+338	2491	+229	3·7
April.......	2·08	2·23	1·99	2·16	+0·23	+243	1978	2221	+179	2441	+220	3·8
May........	2·31	2·39	2·24	2·33	+0·12	+127	2017	2144	− 88	2133	− 11	3·9
June........	2·43	2·47	2·37	2·41	−0·03	− 32	2035	2003	−129	2015	+ 12	4·0
July........	2·40	2·34	2·42	2·43	−0·08	− 85	2040	1955	−186	1817	−138	4·0
August.....	2·32	2·31	2·37	2·31	−0·17	−180	2013	1833	−183	1772	− 61	4·0
September.	2·15	1·99	2·19	2·07	−0·28	−296	1957	1661	−130	1703	+ 42	4·0
October....	1·87	1·75	1·88	1·68	−0·25	−264	1872	1608	− 49	1612	+ 4	4·0
November.	1·62	1·49	1·76	1·84	−0·15	−159	1906	1747	+106	1714	− 33	4·0
December..	1·47	1·45	1·80	1·77	−0·07	− 74	1891	1817	+122	1869	+ 52	3·9
1901												
January....	1·40	1·35	1·68	1·60	−0·22	− 233	1855	1622	− 44	1773	+151	3·8
February...	1·18	1·00	2·32	1·03	−0·24	− 254	1734	1480	+ 64	1686	+206	3·7
March......	0·94	0·88	0·92	0·82	+0·14	+ 148	1691	1839	+338	1818	− 21	3·7
April.......	1·08	1·29	0·94	1·05	+0·22	+ 233	1739	1972	+119	2018	+ 46	3·8
May........	1·30	1·31	1·11	1·17	+0·22	+ 233	1765	1998	− 88	1884	−114	3·9
June........	1·52	1·72	1·43	1·69	+0·30	+ 317	1875	2192	−129	1869	−323	4·0
July........	1·82	1·91	1·78	1·88	+0·02	+ 21	1915	1936	−186	2006	+ 70	4·0
August.....	1·84	1·78	1·79	1·70	−0·10	− 106	1876	1770	−183	1753	− 17	4·0
September.	1·74	1·71	1·72	1·75	−0·22	− 233	1887	1654	−130	1640	− 14	4·0
October....	1·52	1·33	1·64	1·53	−0·28	− 296	1840	1544	− 49	1605	+ 61	4·0
November.	1·24	1·16	1·46	1·39	−0·06	− 63	1810	1747	−106	1650	− 97	4·0
December..	1·18	1·19	1·38	1·37	−0·04	− 42	1806	1764	+122	1869	+105	3·9

a.—The flow of 1000 c. f. s. through the Erie Canal and that of 1100 c. f. s. through the Welland Canal have been omitted.

BETWEEN STAGES 573·7 AND 574·7.

Change in Stage required by last of Month, Foot Depth.	Change in Outflow to give Change in Preceding Column 100 c.f.s.	Expected Regulated Outflow for Month, 100 c.f.s.	Regulated Outflow for First of Month, 100 c.f.c.	Regulated Storage in Lake Erie.		Regulated Lake Level, Buffalo, N.Y., First of Month.	Regulated Level minus regulated level desired, First of Month.	Regulated Lake Level minus actual Lake Level, Buffalo, N.Y.		Regulated Lake Level, Buffalo, N.Y., Mean of Month.	Sluice Gates.
				100 c.f.s.	Foot Depth.			First of Month.	Mean of Month.		
−0·10	+ 106	1962	1962	+ 47	+0·04	3·80	0·00	2·06	2·14	3·82	Part January
−0·14	+ 148	2221	2221	−129	−0·11	+3·84	0·14	2·22	2·10	3·67	Part February
+0·07	− 74	2356	2356	+ 18	+0·02	+3·73	0·03	1·97	1·74	3·69	Open March
+0·15	− 159	2394	2362	+ 86	+0·07	−3·75	0·05	1·50	1·35	3·90	Open April
+0·18	− 190	2170	2170	+ 34	+0·03	−3·82	0·08	1·20	1·18	3·86	Part May
+0·15	− 159	1916	1916	+ 85	+0·07	−3·85	0·15	1·15	1·23	3·95	Part June
+0·08	− 85	1730	1730	+104	+0·09	573·92	0·08	1·31	1·42	573·92	Part July
−0·01	+ 11	1662	1667	− 73	−0·07	+4·01	0·01	1·53	1·67	4·13	Min. August
−0·08	+ 85	1695	1695	− 42	−0·04	+4·08	0·08	1·81	1·92	4·00	Part September
−0·04	+ 42	1646	1667	+ 86	+0·08	+4·04	0·04	2·04	2·10	4·01	Min. October
−0·22	+ 233	2092	2092	−307	−0·26	+4·12	0·12	2·16	1·99	4·00	Part November
−0·06	+ 63	1970	1970	− 13	−0·01	−3·86	0·04	1·82	1·80	3·87	Part December
−0·15	+ 159	2072	2072	−161	−0·14	+3·85	0·05	1·79	1·84	3·89	Part January
−0·01	+ 11	1986	1986	− 47	−0·04	+3·71	0·01	1·89	1·92	3·51	Part February
+0·13	− 137	2140	2140	+128	+0·11	−3·67	0·03	1·95	1·90	3·75	Part March
+0·12	− 127	2320	2320	− 51	−0·04	−3·78	0·02	1·84	1·70	3·74	Part April
+0·26	− 275	1906	1906	+342	+0·29	−3·74	0·16	1·56	1·58	3·90	Part May
−0·03	+ 32	2151	2151	−178	−0·15	+4·03	0·03	1·61	1·50	4·01	Part June
+0·12	− 127	1660	1667	+124	+0·12	−3·88	0·12	1·40	1·56	4·01	Min. July
0·00	0	1608	1667	+ 73	+0·07	4·00	0·00	1·73	1·90	3·99	Min. August
−0·07	+ 74	1684	1684	− 18	−0·02	+4·07	0·07	2·07	2·22	4·12	Part September
−0·05	+ 53	1670	1670	+ 43	+0·04	+4·05	0·05	2·36	2·46	3·94	Part October
−0·19	+ 201	2020	2020	−323	−0·27	+4·09	0·09	2·57	2·32	3·87	Part November
−0·02	+ 21	1840	1840	− 44	−0·04	−3·82	0·08	2·06	2·01	3·97	Part December
−0·08	+ 85	1837	1837	−149	+0·13	−3·78	0·02	1·96	2·12	3·79	Part January
−0·21	+ 222	2272	2272	−119	−0·10	+3·91	0·21	2·27	2·18	3·79	Part February
−0·01	+ 11	2502	2377	−115	−0·10	+3·81	0·11	2·09	1·90	3·72	Open March
+0·19	− 201	2240	2240	− 19	−0·02	−3·71	0·09	1·72	1·58	3·74	Part April
+0·31	− 328	1805	1805	+329	+0·28	+3·69	0·21	1·45	1·52	3·85	Part May
+0·03	− 32	1983	1983	+ 20	+0·02	−3·97	0·03	1·60	1·58	3·99	Part June
+0·01	− 11	1806	1806	+149	+0·13	−3·99	0·01	1·57	1·66	4·09	Part July
−0·12	+ 127	1899	1899	− 66	−0·06	+4·12	0·12	1·75	1·81	4·12	Part August
−0·06	+ 63	1766	1766	−105	−0·09	+4·06	0·06	1·87	1·98	4·05	Part September
+0·03	− 32	1580	1667	− 59	+0·06	−3·97	0·03	2·09	2·12	3·80	Min. October
−0·01	+ 11	1725	1725	+ 22	+0·02	−3·91	0·09	2·15	2·14	3·98	Part November
−0·13	+ 137	2006	2006	−189	−0·16	+3·93	0·03	2·13	2·11	3·88	Part December
−0·07	+ 74	1847	1847	−225	−0·19	−3·77	0·03	2·09	2·18	3·78	Part January
+0·12	−127	1559	1667	−187	−0·18	−3·58	0·12	2·26	2·37	3·40	Min. February
+0·40	−423	1395	1667	+172	+0·16	−3·40	0·30	2·48	2·55	3·37	Min. March
+0·34	−360	1658	1667	+305	+0·29	−3·56	0·24	2·62	2·68	3·73	Min. April
+0·15	−159	1725	1725	+273	+0·23	3·85+	0·05	2·74	2·70	3·87	Part May
−0·08	+ 85	1954	1954	+238	+0·20	+4·08	0·08	2·65	2·58	4·27	Part June
−0·28	+296	2302	2302	−366	−0·31	+4·28	0·28	2·50	2·34	4·22	Part July
+0·03	− 32	1721	1721	+ 49	+0·04	−3·97	0·03	2·18	2·24	3·94	Part August
−0·01	+ 11	1651	1667	− 13	−0·01	+4·01	0·01	2·29	2·32	4·07	Min. September
0·00	0	1605	1667	−123	−0·12	4·00	0·00	2·36	2·39	3·92	Min. October
+0·02	− 21	1629	1667	+ 80	+0·08	−3·88	0·12	2·42	2·50	3·89	Min. November
−0·16	+169	2038	2038	−274	−0·23	+3·96	0·06	2·58	2·46	3·83	Part December

TABLE 33. REGULATION OF LAKE ERIE

Date.	Water Levels of Lake Erie.				Storage in Lake Erie.		Outflow Through Niagara River, 100 c.f.s. *a*	Total Supply to Lake Erie, 100 c.f.s. *a*	Expected Change in total Supply over Preceding Month, 100 c.f.s.	Expected Total Supply for Month, 100 c.f.s.	Expected total Supply minus Total Supply, 100 c.f.s.	Regulated Lake Level Desired, Buffalo, N.Y., First of Month.
	Cleveland, O.		Buffalo, N.Y.									
	First of Month.	Mean of Month.	First of Month.	Mean of Month.	Foot Depth.	100 c.f.s.						
1902												
January....	1·14	1·08	1·39	1·41	−0·28	− 296	1815	1519	− 44	1720	+201	3·8
February...	0·86	0·63	1·10	0·79	−0·08	− 85	1685	1600	+ 64	1583	− 17	3·7
March......	0·78	0·94	0·87	0·95	+0·44	+ 465	1718	2183	+338	1938	−245	3·7
April... ...	1·22	1·49	1·22	1·50	+0·46	+ 486	1834	2320	+119	2362	+ 42	3·8
May........	1·68	1·86	1·62	1·74	+0·31	+ 328	1885	2213	− 88	2232	+ 19	3·9
June........	1·99	2·12	1·90	2·05	+0·44	+ 465	1954	2419	−129	2084	+335	4·0
July........	2·43	2·74	2·39	2·73	+0·30	+ 317	2109	2426	−186	2233	+193	4·0
August.....	2·73	2·72	2·68	2·64	−0·18	190	2089	1899	−183	2243	+344	4·0
September.	2·55	2·38	2·47	2·30	−0·21	− 222	2010	1788	−130	1769	− 19	4·0
October....	2·34	2·29	2·34	2·39	−0·18	− 190	2032	1842	− 49	1739	−103	4·0
November.	2·16	2·02	2·26	2·14	−0·24	− 254	1974	1720	+106	1948	+228	4·0
December..	1·92	1·82	2·17	2·20	−0·15	− 159	1988	1829	+122	1842	+ 13	3·9
1903												
January....	1·77	1·72	2·10	1·99	−0·06	− 63	1940	1877	− 44	1785	− 92	3·8
February...	1·71	1·70	1·84	1·70	+0·28	+ 296	1876	2172	+ 64	1941	−231	3·7
March......	1·99	2·28	1·92	2·13	+0·67	+ 708	1971	2679	+333	2510	−169	3·7
April.......	2·66	3·05	2·48	2·83	+0·41	+ 434	2133	2567	+179	2858	+291	3·8
May........	3·07	3·09	2·84	2·35	0·00	0	2138	2138	− 88	2479	+341	3·9
June........	3·07	3·05	2·90	2·96	−0·05	− 53	2163	2110	−129	2009	−101	4·0
July........	3·02	2·98	2·97	2·99	−0·15	− 159	2173	2014	−186	1924	− 90	4·0
August.....	2·87	2·76	2·82	2·64	−0·19	− 201	2069	1888	−183	1831	− 57	4·0
September.	2·68	2·59	2·60	2·55	−0·26	− 275	2067	1792	−130	1758	− 34	4·0
October....	2·42	2·25	2·46	2·36	−0·41	− 443	2204	1590	− 49	1743	+153	4·0
November.	2·01	1·77	2·18	2·01	−0·47	− 497	1945	1448	+106	1696	+248	4·0
December..	1·54	1·31	2·02	2·02	−0·29	− 307	1947	1640	+122	1570	− 70	3·9
1904												
January....	1·25	1·19	1·54	1·06	−0·01	− 11	1741	1730	− 44	1596	−134	3·8
February...	1·24	1·28	1·18	1·30	+0·33	+ 349	1792	2141	+ 64	1794	−347	3·7
March......	1·57	1·86	1·58	1·86	+0·81	+ 857	1910	2767	+338	2479	−288	3·7
April.......	2·38	2·91	2·38	2·89	+0·66	+ 698	2149	2847	+179	2946	+ 99	3·8
May........	3·04	3·17	3·06	3·23	+0·20	+ 211	2231	2442	− 88	2759	+317	3·9
June........	3·24	3·32	3·36	3·49	+0·12	+ 127	2296	2423	−129	2313	−110	4·0
July........	573·36	573·41	573·45	573·41	−0·10	− 106	2275	2169	−186	2237	+ 68	574·0
August.....	3·26	3·10	3·26	3·12	−0·29	− 307	2204	1897	−183	1986	+ 89	4·0
September	2·97	2·84	2·98	2·84	−0·31	− 328	2136	1808	−130	1767	− 41	4·0
October....	2·66	2·49	2·72	2·61	−0·36	− 381	2082	1701	− 49	1759	+ 58	4·0
November.	2·30	2·12	2·46	2·31	−0·36	− 381	2012	1631	+106	1807	+176	4·0
December..	1·94	1·77	2·22	2·13	−0·30	− 317	1972	1655	+122	1753	+ 98	3·9
1905												
January....	1·64	1·52	1·94	1·74	−0·22	− 233	1885	1652	− 44	1611	− 41	3·8
February...	1·42	1·31	1·48	1·23	−0·18	− 190	1776	1586	+ 64	1716	+130	3·7
March......	1·24	1·18	1·28	1·32	+0·26	+ 275	1795	2070	+338	1924	−146	3·7
April.......	1·50	1·83	1·56	1·79	+0·64	+ 677	1896	2573	+179	2249	−324	3·8
May...	2·14	2·46	2·08	2·38	+0·58	+ 613	2028	2641	− 88	2485	−156	3·9
June........	2·72	2·98	2·68	2·97	+0·30	+ 317	2167	2484	−129	2512	+ 28	4·0
July........	3·02	3·06	3·12	3·28	−0·06	− 63	2243	2180	−186	2298	+118	4·0
August.....	2·96	2·87	3·17	3·06	−0·21	− 222	2188	1966	−183	1997	+ 31	4·0
September.	2·75	2·63	3·96	2·86	−0·28	− 296	2140	1844	−130	1836	− 8	4·0
October....	2·47	2·31	2·76	2·65	−0·35	− 370	2091	1721	− 49	1795	+ 74	4·0
November.	2·12	1·93	2·47	2·29	−0·20	− 211	2008	1797	+106	1827	+ 30	4·0
December..	1·92	1·92	2·37	2·45	+0·01	+ 11	2045	2056	+122	1919	−137	3·9

a.—The flow of 1,000 c.f.s. through the Erie Canal and that of 1,100 c.f.s. through the Welland Canal have been omitted.

BETWEEN STAGES 573·7 AND 574·7.

Change in Stage required by last of Month Foot, Depth.	Change in Outflow to give Change in Preceding Column 100 c.f.s.	Expected Regulated Outflow for Month, 100 c.f.s.	Regulated Outflow for First of Month, 100 c.f.s.	Regulated Storage in Lake Erie.		Regulated Lake Level, Buffalo, N.Y., First of Month.	Regulated Level minus regulated level desired, First of Month.	Regulated Lake Level minus actual Lake Level, Buffalo, N.Y.		Regulated Lake Level, Buffalo, N.Y., Mean of Month.	Sluice Gates.
				100 c.f.s.	Foot Depth.			First of Month.	Mean of Month.		
−0·03	+ 32	1752	1752	−233	−0·20	3·73	−0·07	2·34	2·38	3·79	Part January
+0·17	−180	1403	1667	− 67	−0·06	3·53	−0·17	2·43	2·52	3·31	Min. February
+0·33	−349	1589	1667	+516	+0·49	3·47	−0·23	2·60	2·67	3·62	Min. March
−0·06	+ 63	2425	2416	− 96	−0·08	3·96	+0·16	2·74	2·50	4·00	Open April
+0·12	−127	2105	2105	+108	+0·09	3·88	−0·02	2·26	2·16	2·90	Part May
+0·03	− 32	2205	2052	+367	+0·31	3·97	−0·03	2·07	1·98	4·03	Part June
−0·28	+296	2529	2500	− 74	−0·06	4·28	+0·28	1·89	1·72	4·45	Open July
−0·22	+233	2476	2476	−577	−0·48	4·22	+0·22	1·54	1·40	4·04	Part August
+0·26	−272	1494	1667	+121	+0·11	3·74	−0·26	1·27	1·39	3·69	Min. September
+0·15	−159	1580	1667	+175	+0·17	3·85	−0·15	1·51	1·64	4·03	Min. October
−0·12	+127	2075	2075	−355	−0·30	4·02	+0·02	1·76	1·66	3·80	Part November
+0·08	− 85	1757	1757	+ 72	+0·06	3·72	−0·18	1·55	1·62	3·82	Part December
											1903
−0·08	+885	1870	1870	+ 7	+0·01	3·78	−0·02	1·68	1·82	3·81	Part January
−0·09	+ 95	2036	2036	+136	+0·11	3·79	+0·09	1·95	1·96	3·66	Part February
−0·10	+106	2616	2406	+279	+0·23	3·90	+0·20	1·98	1·82	3·95	Open March
−0·23	+243	3101	2460	+107	+0·09	4·13	+0·33	1·65	1·52	4·35	Open April
−0·22	+233	2712	2484	−346	−0·29	4·22	+0·32	1·38	1·20	4·05	Open May
+0·07	− 74	1935	1935	+175	+0·15	3·93	−0·07	1·03	1·07	4·02	Part June
+0·08	+ 85	2009	2009	+ 5	−0·00	4·08	+0·08	1·11	1·18	4·17	Part July
−0·08	+ 85	1916	1916	− 28	−0·02	4·08	+0·08	1·26	1·36	4·00	Part August
+0·06	+ 63	1821	1821	− 29	−0·02	4·06	+0·06	1·46	1·52	4·07	Part September
−0·04	+ 42	1785	1785	−195	−0·16	4·04	+0·04	1·58	1·64	4·00	Part October
+0·02	− 21	1675	1675	−227	−0·19	3·88	−0·12	1·70	1·68	3·69	Part November
+0·11	−116	1454	1667	− 27	−0·03	3·69	−0·21	1·67	1·90	3·92	Min. December
											1904
+0·04	− 42	1554	1667	+ 63	+0·06	3·66	−0·14	2·12	2·33	3·39	Min. January
−0·02	+ 21	1816	1816	+325	+0·27	3·72	+0·02	2·54	2·48	3·78	Part February
−0·19	+201	2680	2423	+244	+0·29	3·99	+0·29	2·41	2·16	4·02	Open March
−0·38	+402	3348	2500	+347	+0·29	4·28	+0·48	1·90	1·70	4·59	Open April
−0·57	+603	3362	2579	−137	−0·12	4·57	+0·67	1·51	1·30	4·53	Open May
−0·45	+476	2789	2546	−123	−0·10	4·45	+0·45	1·09	1·00	4·49	Open June
−0·35	+370	2607	2518	−349	−0·29	574·35	+0·35	0·90	0·85	574·26	Open July
−0·06	+ 63	2049	2049	−152	−0·13	4·06	+0·06	0·80	0·88	4·00	Part August
+0·07	− 74	1693	1693	+115	+0·10	3·93	−0·07	0·95	1·13	3·97	Part September
−0·03	+ 32	1791	1791	− 90	−0·08	4·03	+0·03	1·31	1·40	4·01	Part October
−0·05	+ 53	1860	1860	−229	−0·19	3·95	−0·05	1·49	1·52	3·83	Part November
+0·04	− 42	1711	1711	− 56	−0·05	3·76	−0·14	1·54	1·66	3·79	Part Deeember
											1905
−0·01	+ 11	1622	1667	− 15	−0·01	3·71	−0·09	1·77	2·00	3·74	Min. January
0·00	0	1716	1716	−130	−0·11	3·70	0·00	2·22	2·26	3·49	Part February
+0·21	−222	1702	1702	+368	+0·31	3·59	−0·11	2·31	2·32	3·64	Part March
0·00	0	2249	2249	+324	+0·27	3·90	+0·10	2·34	2·22	4·01	Part April
−0·17	+180	2665	2471	+170	+0·14	4·17	+0·27	2·09	1·86	4·24	Open May
−0·31	+328	2840	2508	− 24	−0·02	4·31	+0·31	1·63	1·40	4·37	Open June
−0·29	+307	2605	2502	−322	−0·27	4·29	+0·29	1·17	1·01	4·29	Open July
−0·02	+ 21	2018	2018	− 52	−0·04	4·02	+0·02	0·85	0·94	4·00	Part Augus
+0·02	− 21	1815	1815	+ 29	+0·02	3·98	−0·02	1·02	1·13	3·99	Part September
0·00	0	1795	1795	− 74	−0·06	4·00	0·00	1·24	1·36	4·01	Part October
−0·04	+ 42	1869	1869	− 72	−0·06	3·94	−0·06	1·47	1·49	3·78	Part November
−0·08	− 85	2004	2004	+ 52	+0·04	3·88	−0·02	1·51	1·52	3·97	Part December

TABLE 33. REGULATION OF LAKE ERIE

Date.	WATER LEVELS OF LAKE RRIE.				STORAGE IN LAKE ERIE.		Outflow Through Niagara River, 100 c.f.s. *a*	Total Supply to Lake Erie, 100 c.f.s. *a*	Expected Change in total Supply over Preceding Month, 100 c.f.s.	Expected Total Supply for Month, 100 c.f.s.	Expected total Supply minus Total Supply, 100 c.f.s.	Regulated Lake Level Desired, Buffalo, N.Y., First of Month.
	Cleveland, O.		Buffalo, N.Y.									
	First of Month.	Mean of Month.	First of Month.	Mean of Month.	Foot Depth.	100 c.f.s.						
1906												
January....	1·93	1·94	2·39	2·33	+0·01	+ 11	2017	2028	− 44	2012	− 16	3·8
February...	1·94	1·93	2·10	1·88	−0·12	− 127	1915	1788	+ 64	2092	+304	3·7
March......	1·82	1·71	1·77	1·66	+0·10	+ 106	1868	1974	+333	2126	+152	3·7
April.......	1·92	2·13	1·86	2·06	+0·34	+ 360	1956	2316	+179	2153	−163	3·8
May........	2·26	2·40	2·16	2·27	+0·24	+ 254	2004	2258	− 88	2228	− 30	3·9
June........	2·50	2·60	2·38	2·49	+0·12	+ 127	2054	2181	−129	2129	− 52	4·0
July........	2·62	2·64	2·52	2·56	+0·02	+ 21	2070	2091	−186	1995	− 96	4·0
August.....	2·64	2·63	2·54	2·51	−0·15	− 159	2057	1898	−183	1908	+ 10	4·0
September.	2·49	2·35	2·39	2·27	−0·21	− 222	2004	1782	−130	1768	− 14	4·0
October....	2·28	2·21	2·26	2·25	−0·08	− 85	1999	1914	− 49	1733	−181	4·0
November.	2·20	2·18	2·28	2·32	+0·10	+ 106	2015	2121	+106	2020	−101	4·0
December..	2·30	2·42	2·38	2·45	+0·29	+ 307	2045	2252	+122	2243	−109	3·9
1873												
January....	571.21	571.16	571.52	571.41	−0.05	− 53	1814	1761	− 44	1640	−121	573.8
February...	1.16	1.17	1.30	1.20	+0.04	+ 42	1771	1813	+ 64	1825	+ 12	3.7
March......	1.20	1.24	1.21	1.22	+0.68	+ 719	1775	2494	+338	2151	−343	3.7
April.......	1.88	2.52	1.82	2.43	+0.98	+1036	2040	3076	+179	2673	−403	3.8
May........	2.86	3.19	2.76	3.09	+0.37	+ 391	2196	2587	− 88	2988	+401	3.9
June........	3.23	3.27	3.16	3.24	+0.03	+ 32	2234	2226	−129	2458	+192	4.0
July........	3.26	3.25	3.26	3.29	−0.04	− 42	2246	2204	−186	2080	−124	4.0
August.....	3.22	3.19	3.22	3.15	−0.23	− 243	2210	1967	−183	2021	+ 54	4.0
September.	2.99	2.79	2.98	2.81	−0.35	− 370	2129	1759	−130	1837	+ 78	4.0
October....	2.64	2.49	2.69	2.57	−0.25	− 264	2073	1809	− 49	1710	− 99	4.0
November.	2.39	2.29	2.52	2.48	+0.09	+ 95	2051	2146	+106	1915	−231	4.0
December..	2.48	2.66	2.76	3.04	+0.38	+ 402	2185	2587	+122	2268	−319	3.9
1876												
January....	572.38	572.36	572.70	572.61	+0.26	+ 275	2081	2356	− 44	2173	−183	573.8
February...	2.64	2.92	2.78	2.95	+0.60	+ 634	2162	2796	+ 64	2420	−376	3.7
March......	3.24	3.57	3.25	3.55	−0.59	+ 624	2311	2935	+338	3134	+199	3.7
April.......	3.83	4.09	3.78	4.00	+0.42	+ 444	2425	2869	+179	3114	+245	3.8
May........	4.25	4.41	4.16	4.31	+0.21	+ 222	2507	2729	− 88	2781	+ 52	3.9
June........	4.46	4.52	4.40	4.49	0.00	0	2557	2557	−129	2600	+ 43	4.0
July........	4.46	4.41	4.47	4.45	−0.20	− 211	2546	2335	−186	2371	+ 36	4.0
August.....	4.26	4.11	4.26	4.07	−0.24	− 254	2444	2190	−183	2152	− 38	4.0
September.	4.02	3.94	4.02	3.96	−0.34	− 360	2414	2054	−130	2060	+ 6	4.0
October....	3.68	3.41	3.72	3.49	−0.23	− 243	2296	2053	− 49	2005	− 48	4.0
November.	3.45	3.49	3.58	3.68	−0.13	− 137	2344	2207	+106	2159	− 48	4.0
December..	3.32	3.15	3.60	3.53	−0.37	− 391	2306	1915	+122	2329	+414	3.9

a.—The flow of 1,000 c.f.s. through the Erie Canal, and that of 1,100 c.f.s. through the Welland Canal have been omitted.

BETWEEN STAGES 573·7 AND 574·7.

Change in Stage required by last of Month, Foot Depth.	Change in Outflow to give Change in Preceding Column 100 c.f.s.	Expected Regulated Outflow for Month, 100 c.f.s.	Regulated Overflow for First of Month. 100 c.f.s.	Regulated Storage in Lake Erie.		Regulated Lake Level, Buffalo, N.Y., First of Month.	Regulated Level minus regulated level desired, First of Month.	Regulated Lake Level minus actual Lake Level, Buffalo, N.Y.		Regulated Lake Level, Buffalo, N.Y., Mean of Month.	Sluice Gates.
				100 c.f.s.	Foot Depth.			First of Month.	Mean of Month.		
											1906
−0·22	+233	2245	2245	−217	−0·18	3·92	+0·12	1·53	1·58	3·91	Part January
−0·04	+ 42	2134	1234	−346	−0·29	3·74	+0·04	1·64	1·66	3·54	Part February
+0·35	−370	1756	1756	+218	+0·18	3·45	−0·25	1·68	1·72	3·38	Part March
+0·27	−286	1867	1867	+449	+0·38	3·63	−0·17	1·77	1·81	3·87	Part April
−0·01	+ 11	2239	2239	+ 19	+0·02	4·01	+0·11	1·85	1·75	4·02	Part May
−0·03	+ 32	2161	2161	+ 20	+0·02	4·03	+0·03	1,65	1·59	4·08	Part June
−0·05	+ 53	2048	2048	+ 43	+0·04	4·05	+0·05	1·53	1·54	4·10	Part July
−0·09	+ 95	2003	2003	−105	−0·09	4·09	+0·09	1·55	1·58	4·09	Part August
0·00	0	1768	1768	+ 14	+0·01	4·00	0·00	1·61	1·68	3·95	Part September
−0·01	+ 11	1744	1744	+170	+0·14	4·01	+0·01	1·75	1·81	4·06	Part October
−0·25	+264	2284	2284	−163	−0·14	4·15	+0·15	1·87	1·75	4·07	Part November
−0·21	+222	2465	2429	− 77	−0·06	4·01	+0·11	1·63			Open December
−0.10	+ 106	1746	1746	+ 15	+0.01	573.80	0.00	2.28	2.40	573.81	Part January
−0.11	+ 116	1941	1941	−128	−0.11	3.81	+0.11	2.51	2.50	3.70	Part February
+0.10	− 106	2045	2054	+449	+0.38	3.70	0.00	2.49	2.38	3.60	Part March
−0.18	+ 190	2863	2447	+629	+0.53	4.08	+0.28	2.26	2.06	4.49	Open April
−0.61	+ 645	3633	2590	− 3	0.00	4.61	+0.71	1.85	1.65	4.74	Open May
−0.61	+ 645	3103	2590	−324	−0.27	4.61	+0.61	1.45	1.26	4.50	Open June
−0.34	+ 360	2440	2440	−236	−0.20	4.34	+0.34	1.08	1.00	4.29	Part July
−0.14	+ 148	2169	2169	−202	−0.17	4.14	+0.14	0.92	0.96	4.11	Part August
+0.03	− 32	1805	1805	− 46	−0.04	3.97	−0.03	0.99	1.12	3.93	Part September
+0.07	− 74	1636	1667	+142	+0.13	3.93	−0.07	1.24	1.39	3.96	Min. October
−0.16	+ 169	2084	2084	+ 62	+0.05	4.06	+0.06	1.54	1.44	3.92	Part November
−0.31	+ 328	2596	2455	+132	+0.11	4.11	+0.21	1.35			Open December
											1876
−0.10	+ 106	2279	2279	+ 77	+0.06	573.80	0.00	1.10	1.09	573.70	Part January
−0.16	+ 169	2589	2390	+406	+0.34	3.86	+0.16	1.08	1.02	3.97	Open February
−0.40	+ 423	3557	2479	+456	+0.38	4.20	+0.50	0.95	0.88	4.43	Open March
−0.68	+ 719	3833	2582	+287	+0.24	4.58	+0.78	0.80	0.73	4.73	Open April
−0.82	+ 867	3648	2648	+ 81	+0.07	4.82	+0.92	0.66	0.58	4.89	Open May
−0.89	+ 941	3541	2667	−110	−0.09	4.89	+0.89	0.49	0.41	4.90	Open June
−0.80	+ 846	3217	2642	−307	−0.26	4.80	+0.80	0.33	0.30	4.75	Open July
−0.54	+ 571	2723	2571	−381	−0.32	4.54	+0.54	0.28	0.24	4.31	Open August
−0.22	+ 233	2293	2293	−239	−0.20	4.22	+0.22	0.20	0.25	4.21	Part September
−0.02	+ 21	2026	2026	+ 27	+0.02	4.02	+0.02	0.30	0.38	3.87	Part October
−0.14	+ 148	2307	2307	−100	−0.08	4.04	+0.04	0.46	0.41	4.09	Part November
−0.16	+ 169	2498	2416	−501	−0.42	3.96	+0.06	0.36			Open December

TABLE 35. REGULATION OF LAKE ERIE

Date.	Water Levels of Lake Erie. Cleveland, O. First of Month.	Water Levels of Lake Erie. Cleveland, O. Mean of Month.	Water Levels of Lake Erie. Buffalo, N.Y. First of Month.	Water Levels of Lake Erie. Buffalo, N.Y. Mean of Month.	Storage in Lake Erie. Foot Depth.	Storage in Lake Erie. 100 c.f.s.	Outflow Through Niagara River, 100 c.f.s. a	Total Supply to Lake Erie, 100 c.f.s. a	Expected Change in total Supply over Preceding Month, 100 c.f.s.	Expected Total Supply for Month, 100 c.f.s.	Regulated Lake Level Desired, Buffalo, N.Y., First of Month.	Expected total Supply minus Total Supply, 100 c.f.s.
1876												
January....	572.38	572.36	572.70	572.61	+0.26	+ 275	2081	2356	− 44	2173	−183	572.3
February...	2.64	2.92	2.78	2.95	+0.60	+ 634	2162	2796	+ 64	2420	−376	2.2
March......	3.24	2.57	3.25	3.55	+0.59	+ 624	2311	2935	+338	3134	+199	2.2
April.......	3.83	4.09	3.78	4.00	+0.42	+ 444	2425	2869	+179	3114	+245	2.2
May........	4.25	4.41	4.16	4.31	+0.21	+ 222	2507	2729	− 88	2781	+ 52	2.3
June........	4.46	4.52	4.40	4.49	0.00	0	2557	2557	−129	2600	+ 43	2.4
July........	4.46	4.41	4.47	4.45	−0.20	− 211	2546	2335	−186	2371	+ 36	2.5
August.....	4.26	4.11	4.26	4.07	−0.24	− 254	2444	2190	−183	2152	− 38	2.5
September.	4.02	3.94	4.02	3.96	−0.34	− 360	2414	2054	−130	2060	+ 6	2.5
October....	3.68	3.41	3.72	3.49	−0.23	− 243	2296	2053	− 49	2005	− 48	2.5
November.	3.45	3.49	3.58	3.68	−0.13	− 137	2344	2207	+106	2159	− 48	2.5
December..	3.32	3.15	3.60	3.53	−0.37	− 391	2306	1915	+122	2329	+414	2.4
1895												
January....	571.40	571.23	571.76	571.69	−0.28	− 296	1875	1579	− 44	1647	+ 68	572.3
February...	1.12	1.00	1.34	1.00	−0.12	− 127	1728	1601	+ 64	1643	+ 42	2.2
March......	1.00	1.01	0.96	0.92	+0.14	+ 148	1712	1860	+338	1939	+ 79	2.2
April.......	1.14	1.26	1.02	1.13	+0.23	+ 243	1756	1999	+179	2039	+ 40	2.2
May........	1.37	1.48	1.30	1.48	+0.15	+ 159	1829	1988	− 88	1911	− 77	2.3
June........	1.52	1.57	1.53	1.58	0.00	0	1851	1851	−129	1859	+ 8	2.4
July........	1.52	1.46	1.57	1.56	−0.10	+ 106	1846	1740	−186	1665	− 75	2.5
August.....	1.42	1.38	1.49	1.42	−0.09	− 95	1817	1722	−183	1557	−165	2.5
September.	1.33	1.28	1.43	1.44	−0.29	− 307	1821	1514	−130	1592	+ 78	2.5
October....	1.04	0.80	1.32	1.20	−0.29	− 307	1771	1464	− 49	1465	+ 1	2.5
November.	0.75	0.70	0.96	0.71	+0.03	+ 32	1670	1702	+106	1570	−132	2.5
December..	0.78	0.86	0.84	0.97	+0.13	+ 137	1723	1860	+122	1824	− 36	2.4

a.—The flow of 1,000 c.f.s. through the Erie Canal, and that of 1,100 c.f.s. through the Welland Canal have been omitted.

- BETWEEN STAGES 572·0 AND 574·5.

Change in Stage required by last of Month, Foot Depth.	Change in Outflow to give change in Preceding Column 100 c.f.s.	Expected Regulated Outflow for Month, 100 c.f.s.	Regulated Outflow for First of Month, 100 c.f.s.	Regulated Storage in Lake Erie.		Regulated Lake Level, Buffalo, N.Y., First of Month.	Regulated Level minus regulated level desired, First of Month.	Regulated Lake Level minus actual Lake Level, Buffalo, N.Y.		Regulated Lake Level, Buffalo, N.Y., Mean of Month.	Sluice Gates.	
				100 c.f.s. N	Foot Depth.			First of Month.	Mean of Month.			
−0.10	+ 106	2279	2010	+346	+0.29	572.30	0.00	−0.40	−0.30	572.31	Open	January
−0.39	+ 412	2832	2077	+719	+0.60	2.59	+0.39	−0.39	−0.12	2.83	Open	February
−0.99	+1047	4181	2221	+714	+0.60	3.19	+0.99	−0.06	−0.02	3.53	Open	March
−1.49	+1576	4690	2372	+497	+0.42	3.79	+1.59	+0.01	+0.03	4.03	Open	April
−1.81	+1914	4695	2482	+247	+0.21	4.21	+1.91	+0.05	+0.04	4.35	Open	May
−1.92	+2030	4630	2538	+ 19	+0.02	4.42	+2.02	+0.02	0.00	4.49	Open	June
−1.94	+2051	4422	2543	−208	−0.17	4.44	+1.94	−0.03	−0.01	4.44	Open	July
−1.77	+1872	4024	2497	−307	−0.26	4.27	+1.77	+0.01	0.00	4.07	Open	August
−1.51	+1597	3657	2429	−375	−0.32	4.01	+1.51	−0.01	−0.02	3.94	Open	September
−1.19	+1258	3263	2346	−293	−0.25	3.69	+1.19	−0.03	−0.08	3.41	Open	October
−1.04	+1100	3259	2283	− 76	−0.06	3.44	+0.94	−0.14	−0.18	3.50	Open	November
−1.08	+1142	3471	2268	−353	−0.30	3.38	+0.98	−0.20	−0.20	3.33	Open	December
												1895
−0.10	+ 106	1753	1753	−174	−0.15	572.30	0.00	+0.54	+0.68	572.37	Part	January
+0.05	− 53	1590	1667	− 66	−0.06	2.15	−0.05	+0.81	+0.97	1.97	Min.	February
+0.11	− 116	1823	1823	+ 37	+0.03	2.09	−0.11	+1.13	+1.12	2.04	Part	March
+0.18	− 190	1849	1849	+150	+0.13	2.12	−0.08	+1.10	+1.02	2.15	Part	April
+0.15	− 159	1752	1752	+236	+0.20	2.25	−0.05	+0.95	+0.94	2.42	Part	May
+0.05	− 53	1806	1806	+ 45	+0.04	2.45	+0.05	+0.92	+0.92	2.50	Part	June
+0.01	− 11	1654	1667	+ 73	+0.07	2.49	−0.01	+0.92	+1.00	2.56	Min.	July
−0.06	+ 63	1620	1667	+ 55	+0.05	2.56	+0.06	+1.07	+1.12	2.54	Min.	August
−0.11	+ 116	1708	1708	−194	−0.16	2.61	+0.11	+1.18	+1.16	2.60	Part	September
+0.05	− 53	1412	1667	−203	−0.19	2.45	−0.05	+1.13	+1.22	2.42	Min.	October
+0.14	− 148	1422	1667	+ 35	+0.03	2.26	−0.24	+1.30	+1.38	2.09	Min.	November
+0.01	− 11	1813	1813	+ 47	+0.04	2.29	−0.11	+1.45	+1.37	2.34	Part	December

TABLE 36.

EFFECT OF REGULATION OF LAKE ERIE, BETWEEN STAGES 572·0 AND 574·5, ON WATER LEVELS OF LAKE ONTARIO.

Date.	WATER LEVELS OF LAKE ONTARIO AT CHARLOTTE, N.Y.		Actual Rise or Fall during Month, in Feet.	INFLOW FROM NIAGARA RIVER. a		Change in Inflow to Lake Ontario through Regulation of Lake Erie 100 c.f.s.	Effect of Change of Inflow on Level of Lake Ontario, for Month, in Feet.	Effect of change of Outflow through St. Lawrence River on Level of Lake Ontario, in Feet.	Total Effect from change of Inflow and Outflow on Level of Lake Ontario, in Feet.	REGULATED CONDITIONS.		REGULATED LEVEL LESS ACTUAL LEVEL.		Water Levels of Lake Ontario Regulated Conditions, Mean of Month.
	First of Month.	Mean of Month.		Actual Conditions, 100 c.f.s.	Regulated Conditions, 100 c.f.s.					Rise or Fall during Month, in Feet.	Stage of Lake Ontario, First of Month.	First of Month.	Mean of Month.	
1876.														
January	245·28	245·48	+0·52	2081	2049	− 32	−0·035	0·000	−0·035	+0·485	245·280	0·000	−0·018	245·46
February	5·80	6·11	+0·60	2162	2157	− 5	−0·006	+0·011	+0·005	+0·605	5·765	−0·035	−0·032	6·08
March	6·40	6·70	+0·76	2311	2301	− 10	−0·011	+0·010	−0·001	+0·759	6·370	−0·030	−0·030	6·67
April	7·16	7·62	+0·80	2425	2428	+ 3	+0·003	+0·010	+0·013	+0·813	7·129	−0·031	−0·024	7·60
May	7·96	8·30	+0·40	2507	2510	+ 3	+0·003	+0·006	+0·009	+0·409	7·942	−0·018	−0·014	8·29
June	8·36	8·42	+0·07	2557	2541	− 16	−0·017	+0·003	−0·014	+0·056	8·351	−0·009	−0·016	8·40
July	8·43	8·44	−0·20	2546	2520	− 26	−0·028	+0·008	−0·020	−0·220	8·407	−0·023	−0·033	8·41
August	8·23	8·02	−0·55	2444	2462	+ 18	+0·020	+0·014	+0·034	−0·516	8·187	−0·043	−0·026	7·99
September	7·68	7·35	−0·50	2414	2386	− 28	−0·031	+0·003	−0·028	−0·528	7·671	−0·009	−0·023	7·33
October	7·18	7·00	−0·35	2296	2313	+ 17	+0·019	+0·012	+0·031	−0·319	7·143	−0·037	−0·022	6·98
November	6·83	6·66	−0·31	2344	2275	− 69	−0·076	+0·002	−0·074	−0·384	6·824	−0·006	−0·043	6·62
December	6·52	6·39	−0·34	2306	2228	− 78	−0·085	+0·025	−0·060	−0·400	6·140	−0·080	−0·110	6·28
1895.														
January	244·54	244·55	−0·07	1875	1733	−142	−0·157	0·000	−0·157	−0·227	244·540	0·000	−0·078	244·47
February	4·47	4·39	−0·07	1728	1667	− 61	−0·068	+0·047	−0·021	−0·091	4·313	−0·157	−0·168	4·22
March	4·40	4·40	+0·17	1712	1827	+115	+0·127	+0·053	+0·180	+0·350	4·222	−0·178	−0·088	4·31
April	4·57	4·74	+0·28	1756	1866	+110	+0·122	−0·001	+0·121	+0·401	4·572	+0·002	+0·062	4·80
May	4·85	4·96	+0·03	1829	1779	− 50	−0·055	−0·037	−0·092	−0·062	4·973	+0·123	+0·077	5·04
June	4·88	4·79	−0·22	1851	1811	− 40	−0·014	−0·009	−0·053	−0·273	4·911	+0·031	+0·001	4·79
July	4·66	4·53	−0·26	1846	1667	−179	−0·198	+0·007	−0·191	−0·451	4·638	−0·022	−0·118	4·41
August	4·40	4·26	−0·25	1817	1667	−150	−0·166	+0·064	−0·102	−0·352	4·187	−0·213	−0·264	4·00
September	4·15	4·04	−0·31	1821	1687	−134	−0·149	+0·091	−0·058	−0·368	3·835	−0·315	−0·344	3·70
October	3·84	3·64	−0·32	1771	1667	−104	−0·116	+0·108	−0·008	−0·328	3·467	−0·373	−0·377	3·26
November	3·52	3·41	−0·06	1670	1667	− 3	−0·003	+0·110	+0·107	+0·047	3·139	−0·381	−0·328	3·08
December	3·46	3·51	+0·18	1723	1818	+ 95	+0·106	+0·079	+0·185	+0·365	3·186	−0·274	−0·182	3·33

a.—The flow of 1,000 c.f. s. through the Erie Canal and that of 1,100 c. f. s. through the Welland Canal have been omitted.

TABLE 38.

REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4,000 CUBIC FEET PER SECOND THROUGH THE CHICAGO DRAINAGE CANAL.

Date.	Water Levels of St. Marys River at Sault Ste. Marie, Mich.			Total Supply to Lake Superior	Assumed Constant Outflow through St. Marys River,	Total Supply less Constant Outflow,	Effect of Change of Outflow on stage of Lake Superior for Month,	Regulated Level less Actual Level at Sault Ste. Marie, Mich.		Water Levels of St. Marys River at Sault Ste. Marie Regulated Conditions, Mean of Month.
	Actual Conditions.		Regulated Conditions.							
	First of Month.	Mean of Month.	First of Month.	100 c.f.s.	100 c.f.s.	100 c.f.s.	in Feet.	First of Month.	Mean of Month.	
1888										
May		601·43								
June	601·855	2·28	601·855	2606	697	+1909	+0·543	0·000	+0·019	602·299
July	2·36	2·44	2·398	1553	697	+ 856	+0·243	+0·038	+0·122	2·562
August	2·435	2·43	2·641	1143	697	+ 446	+0·127	+0·206	+0·292	2·722
September	2·39	2·35	2·768	734	697	+ 37	+0·011	+0·378	+0·406	2·756
October	2·345	2·34	2·779	578	697	− 119	−0·034	+0·434	+0·470	2·810
November	2·24	2·14	2·745	90	697	− 607	−0·173	+0·505	+0·554	2·694
December	1·97	1·80	2·572	− 361	697	−1058	−0·301	+0·602	+0·606	2·406
1889										
January	1·66	1·52	2·271	− 196	697	− 893	−0·254	+0·611	+0·626	2·146
February	1·375	1·23	2·017	1	697	− 696	−0·198	+0·642	+0·608	1·838
March	1·245	1·26	1·819	398	697	− 299	−0·085	+0·574	+0·526	1·788
April	1·255	1·25	1·734	1280	697	+ 583	+0·166	+0·479	+0·427	1·677
May	1·525	1·81	1·900	1579	697	+ 882	+0·251	+0·375	+0·313	2·123
June	1·90	1·99	2·151	1343	697	+ 646	+0·184	+0·251	+0·230	2·290
July	2·125	2·26	2·335	1516	697	+ 819	+0·233	+0·210	+0·256	2·516
August	2·265	2·27	2·568	1416	697	+ 719	+0·204	+0·303	+0·405	2·675
September	2·265	2·26	2·772	819	697	+ 122	+0·035	+0·507	+0·564	2·824
October	2·185	2·11	2·807	41	697	− 656	−0·187	+0·622	+0·641	2·751
November	1·96	1·81	2·620	− 257	697	− 954	−0·271	+0·660	+0·694	2·504
December	1·62	1·43	2·349	− 44	697	− 741	−0·211	+0·729	+0·706	2·136
1890										
January	1·455	1·48	2·138	255	697	− 442	−0·126	+0·683	+0·745	2·225
February	1·205	0·93	2·012	− 25	697	− 722	−0·205	+0·807	+0·844	1·774
March	0·925	0·92	1·807	143	697	− 554	−0·158	+0·882	+0·823	1·743
April	0·885	0·85	1·649	894	697	+ 197	+0·056	+0·764	+0·692	1·542
May	1·085	1·32	1·705	1804	697	+1107	+0·315	+0·620	+0·515	1·835
June	1·61	1·90	2·020	2073	697	+1376	+0·391	+0·410	+0·370	2·270

ABLE 38—Continued.

REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4,000 CUBIC FEET PER SECOND THROUGH THE CHICAGO DRAINAGE CANAL.

Date.	Water Levels of St. Marys River at Sault Ste. Marie, Mich. — Actual Conditions. First of Month.	Water Levels of St. Marys River at Sault Ste. Marie, Mich. — Actual Conditions. Mean of Month.	Water Levels of St. Marys River at Sault Ste. Marie, Mich. — Regulated Conditions. First of Month.	Total Supply to Lake Superior 100 c.f.s.	Assumed Constant Outflow through St Marys River, 100 c.f.s.	Total Supply less Constant Outflow, 100 c.f.s.	Effect of Change of Outflow on stage of Lake Superior for Month, in Feet.	Regulated Level less Actual Level at Sault Ste. Marie, Mich. First of Month.	Regulated Level less Actual Level at Sault Ste. Marie, Mich. Mean of Month.	Water Levels of St. Marys River at Sault Ste. Marie Regulated Conditions, Mean of Month.
1890—con.										
July	2·08	2·26	2·411	1635	697	+ 938	+0·267	+0·331	+0·397	2·657
August	2·215	2·17	2·678	1328	697	+ 631	+0·179	+0·463	+0·602	2·772
September	2·115	2·06	2·857	1000	697	+ 303	+0·086	+0·742	+0·830	2·890
October	2·025	1·99	2·943	408	697	− 289	−0·082	+0·918	+0·930	2·920
November	1·92	1·85	2·861	− 181	697	− 878	−0·250	+0·941	+0·926	2·776
December	1·70	1·55	2·610	− 496	697	−1193	−0·339	+0·910	+0·988	2·538
1891										
January	1·205	0·86	2·271	− 243	697	− 940	−0·267	+1·066	+1·078	1·938
February	0·915	0·97	2·004	323	697	− 374	−0·106	+1·089	+1·046	2·016
March	0·895	0·82	1·898	446	697	− 251	−0·071	+1·003	+0·960	1·780
April	0·91	1·00	1·827	890	697	+ 193	+0·055	+0·917	+0·792	1·792
May	1·215	1·43	1·882	1129	697	+ 432	+0·123	+0·667	+0·634	2·064
June	1·405	1·38	2·005	1119	697	+ 422	+0·120	+0·600	+0·645	2·025
July	1·435	1·49	2·125	1022	697	+ 325	+0·092	+0·690	+0·706	2·196
August	1·495	1·50	2·217	616	697	− 81	−0·023	+0·722	+0·726	2·226
September	1·465	1·43	2·194	789	697	+ 92	+0·026	+0·729	+0·744	2·174
October	1·46	1·49	2·220	665	697	− 32	−0·009	+0·760	+0·768	2·258
November	1·435	1·38	2·211	− 139	697	− 836	−0·238	+0·776	+0·762	2·142
December	1·225	1·07	1·973	3	697	− 694	−0·197	+0·748	+0·760	1·830
1892										
January	1·04	1·01	1·776	144	697	− 553	−0·157	+0·772	+0·780	1·790
February	0·83	0·65	1·619	− 149	697	− 846	−0·241	+0·789	+0·804	1·454
March	0·56	0·47	1·378	308	697	− 389	−0·111	+0·818	+0·768	1·238
April	0·55	0·63	1·267	1122	697	+ 425	+0·121	+0·717	+0·610	1·240
May	0·885	1·14	1·388	1853	697	+1156	+0·329	+0·503	+0·450	1·590
June	1·32	1·50	1·717	1415	697	+ 718	+0·204	+0·397	+0·374	1·874
July	1·57	1·64	1·921	1001	697	+ 304	+0·086	+0·351	+0·356	1·996
August	1·645	1·65	2·007	1037	697	+ 340	+0·097	+0·362	+0·393	2·043

September	1·68	1·71	2·104	675	697	− 22	−0·006	+0·424	+0·434	2·144
October	1·655	1·60	2·098	279	697	− 418	−0·119	+0·443	+0·481	2·081
November	1·46	1·32	1·979	− 83	697	− 780	−0·222	+0·519	+0·548	1·868
December	1·18	1·04	1·757	− 326	697	−1023	−0·291	+0·577	+0·564	1·604
1893										
January	0·915	0·79	1·466	− 110	697	− 807	−0·230	+0·551	+0·548	1·338
February	0·69	0·59	1·236	414	697	− 283	−0·080	+0·546	+0·554	1·144
March	0·595	0·60	1·156	739	697	+ 42	+0·012	+0·561	+0·502	1·102
April	0·725	0·85	1·168	1551	697	+ 854	+0·243	+0·443	+0·360	1·210
May	1·135	1·42	1·411	2372	697	+1675	+0·476	+0·276	+0·239	1·659
June	1·685	1·95	1·887	2132	697	+1435	+0·408	+0·202	+0·224	2·174
July	2·05	2·15	2·295	1387	697	+ 690	+0·196	+0·245	+0·273	2·423
August	2·19	2·23	2·491	739	697	+ 42	+0·012	+0·301		
September	2·165	2·10	2·503							

TABLE 39.

REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4000 FEET PER SECOND THROUGH THE CHICAGO DRAINAGE CANAL.

	WATER LEVELS OF ST. MARYS RIVER AT SAULT STE. MARIE, MICH.			Total Supply to Lake Superior	Assumed Constant Outflow through St. Marys River,	Total Supply less Constant Outflow,	Effect of Change of Outflow on stage of Lake Superior for Month,	REGULATED LEVEL LESS ACTUAL LEVEL AT SAULT STE. MARIE, MICH.		Water Levels of St. Marys River at Sault Ste. Marie Regulated Conditions, Mean of Month.
	Actual Conditions.		Regulated Conditions.							
	First of Month.	Mean of Month.	First of Month.	100 c.f.s.	100 c.f.s.	100 c.f.s.	in Feet.	First of Month.	Mean of Month.	
1888										
May		601·43								
June	601·855	2·28	601·855	2606	797	+ 1809	+0·514	0·000	+0·004	602·284
July	2·36	2·44	2,369	1553	797	+ 756	+0·215	+0·009	+0·079	2·519
August	2,435	2·43	2·584	1143	797	+ 346	+0·098	+0·149	+0·220	2·650
September	2·39	2·35	2·682	734	797	− 63	−0·018	+0·292	+0·306	2·656
October	2·345	2·34	2·664	578	797	− 219	−0·062	+0·319	+0·340	2·680
November	2·24	2·14	2·602	90	797	− 707	−0·201	+0·362	+0·396	2·536
December	1·97	1·80	2·401	−361	797	− 1158	−0·329	+0·431	+0·422	2·222
1889										
January	1·66	1·52	2·072	− 196	797	− 993	−0·282	+0·412	+0·414	1·934
February	1·375	1·23	1·790	1	797	− 796	−0·226	+0·415	+0·367	1·597
March	1·245	1·22	1·564	398	797	− 399	−0·113	+0·319	+0·258	1·518
April	1·255	1·25	1·451	1280	797	+ 483	+0·137	+0·196	+0·130	1·380
May	1·525	1·81	1·588	1579	797	+ 782	+0·222	+0·063	−0·014	1·796
June	1·90	1·99	1·810	1343	797	+ 546	+0·155	−0·090	−0·125	1·865
July	2·125	2·26	1·965	1516	797	+ 719	+0·204	−0·160	−0·128	2·132
August	2·265	2·27	2·169	1416	797	+ 619	+0·176	−0·096	−0·008	2·262
September	2·265	2·26	2·345	819	797	+ 022	+0·006	+0·080	+0·123	2·383
October	2·185	2·11	2·351	41	797	− 756	−0·215	+0·166	+0·171	2·281
November	1·96	1·81	2·136	− 257	797	− 0154	−0·300	+0·176	+0·196	2·006
December	1·62	1·43	1·836	− 44	797	− 841	−0·239	+0·216	+0·179	1·609
1890										
January	1·455	1·49	1·597	255	797	− 542	−0·154	+0·142	+0·190	1·670
February	1,205	0·93	1·443	− 25	797	− 882	−0·234	+0·238	+0·261	1·191
March	0·925	0·92	1·209	143	797	− 653	−0·186	+0·284	+0·211	1·131
April	0·885	0·85	1·203	894	797	+ 974	+0·028	+0·138	+0·052	0·902
May	1·085	1·32	1·051	1804	797	+ 1007	+0·286	−0·034	−0·154	1·166

June	1·61	1·90	1·337	2073	797	+ 1276	+0·363	−0·273	−0·326	1·574
July	2·08	2·26	1·700	1635	797	+ 838	+0·238	−0·380	−0·328	1·932
August	2·215	2·17	1·938	1328	797	+ 531	−0·151	−0·277	−0·152	2·018
September	2·115	2·06	2·089	1000	797	+ 203	+0·058	−0·026	+0·048	2·108
October	2·025	1·99	2·147	408	797	− 383	−0·111	−0·122	−0·119	2·109
November	1·92	1·85	2·036	181	797	− 978	+0·278	+0·116	+0·087	1·937
December	1·70	1·55	1·758	− 496	797	−1,293	−0·368	+0·058	+0·122	1·672
1891										
January	1·205	0·86	1·390	− 243	797	− 1040	−0·296	+0·185	+0·182	1·042
February	0·915	0·97	1·094	323	797	− 474	−0·135	+0·179	+0·122	1·092
March	0·895	0·82	0·959	446	797	− 351	−0·100	+0·064	+0·006	0·826
April	0·91	1·00	0·959	890	797	+ 93	+0·026	−0·051	−0·190	0·810
May	1·215	1·43	0·885	1129	797	+ 332	+0·094	−0·330	−0·378	1·052
June	1·405	1·38	0·979	1119	797	+ 322	+0·092	−0·426	−0·395	0·985
July	1·435	1·49	1·071	1022	797	+ 331	+0·064	−0·364	−0·362	1·128
August	1·495	1·50	1·135	616	797	+ 181	−0·051	−0·360	−0·370	1·130
September	1·465	1·43	1·084	789	797	− 8	−0·002	−0·380	−0·380	1·050
October	1·46	1·49	1·082	665	797	− 132	−0·038	−0·378	−0·384	1·106
November	1·435	1·38	1·044	− 139	797	− 936	−0·266	−0·391	−0·419	0·961
December	1·225	1·07	0·788	3	797	− 794	−0·226	−0·447	−0·472	0·598
1892										
January	1·04	1·01	0·552	144	797	− 653	−0·186	−0·498	−0·481	0·529
February	0·83	0·65	0·366	− 149	797	− 946	−0·269	−0·464	−0·464	0·186
March	0·56	0·47	0·097	308	797	− 489	−0·139	−0·463	−0·528	599·942
April	0·55	0·63	599·958	1122	797	+ 325	+0·092	−0·592	−0·714	9·916
May	0·885	1·14	600·050	1853	797	+ 1056	+0·300	−0·835	−0·902	600·238
June	1·32	1·50	0·350	1415	797	+ 618	+0·176	−0·970	−1·007	0·493
July	1·57	1·64	0·526	1001	797	+ 204	+0·058	−0·144	−0·052	0·588
August	1·645	1·65	0·584	1037	797	+ 240	−0·068	−0·061	−0·144	0·606
September	1·68	1·71	0·652	675	797	− 122	−0·035	−0·028	−1·033	0·677
October	1·655	1·60	0·617	279	797	− 518	−0·147	−0·138	−1·014	0·586
November	1·46	1·32	0·470	− 83	797	− 880	−0·250	−0·990	−0·975	0·345
December	1·18	1·04	0·220	− 326	797	− 1123	−0·319	−0·960	−0·987	0·053
1893										
January	0·915	0·79	599·901	−110	797	− 907	−0·258	−1·014	−1·030	599·760
February	0·69	0·59	9·643	414	797	− 383	−0·109	−1·047	−1·054	9·536
March	0·595	0·60	9·534	739	797	− 58	−0·016	−1·061	−1·134	9·466
April	0·725	0·85	9·518	1551	797	+ 754	+0·214	−1·207	−1·305	9·545
May	1·135	1·42	9·732	2372	797	+ 1575	+0·448	−1·403	−1·454	9·966
June	1·685	1·95	600·180	2132	797	+ 1335	+0·380	−1·505	−1·498	600·452
July	2·05	2·15	0·560	1387	797	+ 590	+0·168	−1·490	−1·476	0·674
August	2·19	2·23	0·728	739	797	− 58	−0·016	−1·462		
September	2·165	2·10	0·712	562	797					

TABLE 40.

EFFECT ON WATER LEVELS OF LAKE MICHIGAN-
TO COMPENSATE FOR DIVERSION OF 4000 CUBIC FEET

Date.	Water Levels of Lake Michigan-Huron. Mean, Milwaukee and Harbour Beach. First of Month.	Mean of Month.	Rise or Fall in Stage of Lake Michigan-Huron During Month, in Feet.	Regulated Less Actual Transmitted Supply 100 c.f.s.	Net Change in Dupply,a 100 c.f.s.	Effect of Net Change in Supply on Stage of Lake Michigan-Huron. Foot Depth	Effect of Change in Outflow through St. Clair River on Stage of Lake Michigan-Huron. Foot Depth
1888							
May..........		581.985					
June..........	582.128	2.270	+0.152	−259	−299	−0.0609	0.0000
July..........	2.280	2.290	−0.010	−295	−335	−0.0682	+0.0026
August........	2.270	2.250	−0.130	−293	−333	−0.0678	+0.0055
September.. ..	2.140	2.030	−0.248	−275	−315	−0.0643	+0.0074
October.......	1.892	1.755	−0.194	−272	−312	−0.0636	+0.0096
November....	1.698	1.640	−0.256	−226	−266	−0.0543	+0.0117
December.....	1.442	1.245	−0.237	− 81	−121	−0.0247	+0.0134
1889							
January.......	1.205	1.165	−0.067	− 25	− 65	−0.0133	+0.0127
February......	1.138	1.110	−0.038	+ 33	− 7	−0.0014	+0.0128
March.........	1.100	1.090	−0.025	+ 27	− 13	−0.0027	+0.0124
April..........	1.075	1.060	+0.040	+ 29	− 11	−0.0022	+0.0120
May...........	1.115	1.170	+0.253	− 83	−123	−0.0251	+0.0117
June...........	1.368	1.565	+0.307	−119	−159	−0.0324	+0.0131
July...........	1.675	1.785	+0.035	−173	−213	−0.0435	+0.0139
August.........	1.710	1.635	−0.160	−175	−215	−0.0439	+0.0151
September.....	1.550	1.465	−0.240	−173	−213	−0.0435	+0.0162
October.......	1.310	1.155	−0.328	−143	−183	−0.0374.	+0.0159
November....	0.982	0.810	−0.257	− 83	−123	−0.0251	+0.0167
December.....	0.725	0.640	−0.047	− 7	− 47	−0.0096	+0.0170
1890							
January.......	0.678	0.715	−0.003	− 17	− 57	−0.0116	+0.0167
February......	0.675	0.635	−0.050	+ 93	+ 53	+0.0108	+0.0166
March.........	0.625	0.615	+0.105	+ 95	+ 55	+0.0112	+0.0156
April..........	0.730	0.845	+0.250	+109	+ 69	+0.0141	+0.0146
May...........	0.980	1.115	+0.345	+ 15	− 25	−0.0051	+0.0136
June...........	1.325	1.535	+0.275	−101	−141	−0.0288	+0.0133
July...........	1.600	1.665	+0.045	−173	−213	−0.0435	+0.0150
August.........	1.654	1.625	−0.137	−155	−195	−0.0398	+0.0161
September.....	1.508	1.390	−0.198	−133	−173	−0.0353	+0.0170
October.......	1.310	1.230	−0.215	−119	−159	−0.0325	+0.0164
November....	1.095	0.960	−0.297	− 91	−131	−0.0268	+0.0170
December.....	0.798	0.635	−0.218	− 31	− 71	−0.0145	+0.0173
1891							
January.......	580·580	580·525	−0·142	+107	+ 67	+0·0137	+0·0172
February......	0·433	0·350	−0·048	+ 85	+ 45	+0·0092	+0·0148
March.........	0·390	0·430	+0·200	+115	+ 75	+0·0153	+0·0140
April..........	0·590	0·750	+0·245	+ 79	+ 39	+0·0080	+0·0142
May...........	0·835	0·920	+0·110	− 7	− 47	−0·0096	+0·0134
June...........	0·945	0·970	−0·010	+ 3	− 37	−0·0076	+0·0132
July...........	0·935	0·900	+0·077	− 19	− 59	−0·0121	+0·0130
August.........	0·858	0·815	−0·148	− 21	− 61	−0·0125	+0·0130
September.....	0·710	0·605	−0·288	− 7	− 47	−0·0096	+0·0130
October.......	0·422	0·240	−0·360	− 19	− 59	−0·0121	+0·0129
November ...	0·062	579·885	−0·207	+ 3	− 37	−0·0076	+0·0117
December.....	579·855	9·825	+0·005	+ 65	+ 25	+0·0051	+0·0116

a.—Net change = regulated transmitted supply from Lake Superior − diversion through Chicago Drainage Canal—actual transmitted supply from Lake Superior.

Regulated transmitted supply from Lake Superior, with diversion through Chicago Drainage Canal of 4000 c. f. s. = 65700 c. f. s. + 4000 c. f. s. = 69700 c. f. s.

HURON, BY REGULATION OF LAKE SUPERIOR

PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

Total Effect, net Change in Supply and Outflow on Stage of Lake Michigan-Huron.	Regulated Conditions.		Regulated Stage Less Actual Stage of Lake Michigan-Huron.		Discharge Increment of St. Clair River per foot Rise of Lake Level.	Change in Outflow of St. Clair River.	Regulated Conditions, Stage of Lake Michigan-Huron.
	Rise or Fall in Stage of Lake Michigan-Huron During Month,	Stage of Lake Michigan-Huron.					
Foot Depth.	in Feet.	First of Month.	First of Month.	Mean of Month.	100 c.f.s.	100 c.f.s.	Mean of Month.
−0.0609	+0.091	582.128	0.000	−0.030	209	− 6	582.240
−0.0656	−0.076	2.219	−0.061	−0.094	209	−20	2.196
−0.0623	−0.192	2.143	−0.127	−0.158	209	−33	2.092
−0.0569	−0.305	1.951	−0.189	−0.218	191	−42	1.812
−0.0540	−0.248	1.646	−0.146	−0.273	191	−52	1.482
−0.0426	−0.299	1.398	−0.300	−0.322	191	−61	1.318
−0.0113	−0.248	1.099	−0.343	−0.348	191	−67	0.897
−0.0006	−0.068	0.851	−0.354	−0.354	175	−62	0.811
+0.0114	−0.027	0.783	−0.355	−0.350	175	−61	0.760
+0.0097	−0.015	0.756	−0.344	−0.339	175	−59	0.751
+0.0098	+0.050	0.741	−0.334	−0.329	175	−58	0.731
−0.0134	+0.240	0.791	−0.324	−0.330	175	−58	0.840
−0.0193	−0.288	1.031	−0.337	−0.346	191	−66	1.219
−0.0296	+0.005	1.319	−0.356	−0.371	191	−71	1.414
−0.0288	−0.189	1.324	−0.386	−0.400	191	−76	1.235
−0.0273	−0.267	1.135	−0.415	−0.428	191	−82	1.037
−0.0215	−0.350	0.868	−0.442	−0.453	175	−79	0.702
−0.0084	−0.265	0.518	−0.464	−0.468	175	−82	0.342
+0.0074	−0.040	0.253	−0.472	−0.468	175	−82	0.172
+0.0051	+0.002	0.213	−0.465	−0.462	175	−81	0.253
+0.0274	−0.023	0.215	−0.460	−0.446	175	−78	0.189
+0.0268	+0.132	0.192	−0.443	−0.420	175	−73	0.195
+0.0287	+0.279	0.324	−0.406	−0.392	175	−69	0.453
+0.0085	+0.353	0.603	−0.377	−0.373	175	−65	0.742
−0.0155	+0.259	0.956	−0.369	−0.377	175	−66	1.158
−0.0285	+0.017	1.215	−0.385	0.399	191	−76	1.266
−0.0237	−0.161	1.232	−0.413	−0.425	191	−81	1.200
−0.0183	−0.216	1.071	−0.437	−0.446	191	−85	0.944
−0.0161	−0.231	0.855	−0.455	−0.463	175	−81	0.767
−0.0098	−0.307	0.624	−0.471	−0.476	175	−83	0.484
+0.0028	−0.215	0.317	−0.481	−0.480	175	−84	0.155
+0·0309	−0·111	580·102	−0·478	−0·462	175	−81	580·063
+0·0240	−0·024	579·991	−0·447	−0·435	163	−71	579·915
+0·0293	+0·229	9·967	−0·423	−0·408	163	−67	580·022
+0·0222	+0·267	580·196	−0·394	−0·383	175	−67	0·367
+0·0038	+0·114	0·463	−0·372	−0·370	175	−65	0·550
+0·0057	−0·004	0·577	−0·368	−0·365	175	−64	0·605
+0·000	−0·076	0·573	−0·362	−0·362	175	−63	0·538
+0·0009	−0·076	0·573	−0·362	−0·362	175	−63	0·538
+0·0005	−0·147	0·497	−0·361	−0·360	175	−63	0·455
+0·0034	−0·285	0·350	−0·360	−0·358	175	−63	0·247
+0·0008	−0·359	0·065	−0·357	−0·356	175	−62	579·884
+0·0041	−0·203	579·706	−0·356	−0·354	163	−58	9·531
+0·0167	+0·022	9·503	−0·352	−0·344	163	−56	9·481

TABLE 40.

EFFECT ON WATER LEVELS OF LAKE MICHIGAN-
TO COMPENSATE FOR DIVERSION OF 4,606 CUBIC FEET

Date.	WATER LEVELS OF LAKE MICHIGAN-HURON. MEAN, MILWAUKEE AND HARBOUR BEACH. First of Month.	WATER LEVELS OF LAKE MICHIGAN-HURON. MEAN, MILWAUKEE AND HARBOUR BEACH. Mean of Month.	Rise or Fall in Stage of Lake Michigan-Huron During Month, in Feet.	Regulated Less Actual Transmitted Supply 100 c.f.s.	Net Change in Dupply,a 100 c.f.s.	Effect of Net Change in Supply on Stage of Lake Michigan-Huron. Foot Depth	Effect of Change in Outflow through St. Clair River on Stage of Lake Michigan-Huron. Foot Depth
1892							
January	9·860	9·895	+0·068	+ 77	+ 37	+0·0076	+0·0111
February	9·928	9·960	+0·022	+149	+109	+0·0223	+0·0104
March	9·950	9·940	+0·035	+185	+145	+0·0297	+0·0093
April	9·985	580·030	+0·173	+153	+113	+0·0231	+0·0081
May	580·158	0·235	+0·372	+ 51	+ 11	+0·0023	+0·0070
June	0·530	0·775	+0·320	− 21	− 61	−0·0125	+0·0073
July	0·850	0·925	+0·115	− 49	− 89	−0·0182	+0·0075
August	0·965	1·005	−0·053	− 51	− 91	−0·0186	+0·0079
September	0·912	0·820	−0·204	− 63	−103	−0·0210	+0·0083
October	0·703	0·595	−0·263	− 41	− 81	−0·0165	+0·0088
November	0·445	0·295	−0·277	+ 15	− 25	−0·0051	+0·0091
December	0·168	0·040	−0·193	+ 71	+ 31	+0·0063	+0·0082
1893							
January	579·975	579·910	−0·043	+178	+138	+0·0282	+0·0077
February	9·932	9·955	+0·070	+215	+175	+0·0358	+0·0065
March	580·002	580·050	+0·258	+213	+173	+0·0354	+0·0051
April	0·260	0·470	+0·442	+166	+126	+0·0257	+0·0042
May	0·702	0·935	+0·398	+ 59	+ 19	+0·0039	+0·0031
June	1·100	1·265	+0·205	− 41	− 81	−0·0165	+0·0031
July	1·305	1·345	−0·037	− 78	−118	−0·0241	+0·0036
August	1·258	1·190	−0·233	− 93	−133	−0·0271	+0·0044

a.—Net change=regulated transmitted supply from Lake Superior—diversion through Chicago Drainage Canal—actual transmitted supply from Lake Superior. Regulated transmitted supply from Lake Superior, with diversion through Chicago Drainage Canal of 4000 c.f.s.=65700 c.f.s. + 4 000 c.f.s. = 69700 c.f.s.

HURON, BY REGULATION OF LAKE SUPERIOR

PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

Total Effect, net Change in Supply and Outflow on Stage of Lake Michigan-Huron.	Regulated Conditions.		Regulated Stage Less Actual Stage of Lake Michigan-Huron.		Discharge Increment of St. Clair River per foot Rise of Lake Level.	Change in Outflow of St. Clair River.	Regulated Conditions, Stage of Lake Michigan-Huron.
	Rise or Fall in Stage of Lake Michigan-Huron During Month,	Stage of Lake Michigan-Huron.					
Foot Depth.	in Feet.	First of Month.	First of Month.	Mean of Month.	100 c.f.s.	100 c.f.s.	Mean of Month.
+0·0187	+0·087	9·525	−0·335	−0·326	163	−53	9·569
+0·0327	+0·055	9·612	−0·316	−0·300	163	−49	9·660
+0·0390	+0·074	9·677	−0·283	−0·264	163	−43	9·676
+0·0312	+0·204	9·741	−0·244	−0·228	163	−37	9·802
+0·0093	+0·381	9·945	−0·213	−0·208	163	−34	580·077
−0·0052	+0·315	580·326	−0·204	−0·206	175	−36	0·569
−0·0107	+0·104	0·641	−0·209	−0·214	175	−38	0·711
−0·0107	−0·064	0·745	−0·220	−0·225	175	−39	0·779
−0·0127	−0·217	0·681	−0·231	−0·238	175	−42	0·582
−0·0077	−0·271	0·464	−0·244	−0·248	175	−43	0·347
+0·0040	−0·273	0·193	−0·252	−0·250	175	−44	0·045
+0·0145	−0·179	579·920	−0·248	−0·241	163	−39	579·799
+0·0359	−0·007	9·741	−0·234	−0·216	163	−35	9·694
+0·0423	+0·112	9·734	−0·198	−0·177	163	−29	9·778
+0·0405	+0·298	9·846	−0·156	−0·136	163	−22	9·914
+0·0299	+0·472	580·144	−0·116	−0·101	175	−18	580·369
+0·0070	+0·405	0·616	−0·086	−0·082	175	−14	0·853
−0·0134	+0·192	1·021	−0·079	−0·085	191	−15	1·179
−0·0205	−0·057	1·213	−0·092	−0·102	191	−18	1·243
−0·0027	−0·256	1·156	−0·112	−0·124	191	−24	1·066

TABLE 41. EFFECT ON WATER LEVELS OF LAKE ERIE, BY REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4,000 CUBIC FEET PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

Date.	WATER LEVELS OF LAKE ERIE AT CLEVELAND, O.		Rise or Fall in Stage of Lake Erie during Month,	Net Change in Trans-mitted Supply,	Effect of Net Change in Trans-mitted Supply on Stage of Lake Erie,	Effect of Change in Outflow through Niagara River on Stage of Lake Erie,	Total Effect Net Change Trans-mitted Supply and Outflow, on Stage of Lake Erie,	REGULATED CONDITIONS.		REGULATED STAGE LESS ACTUAL STAGE OF LAKE ERIE.		Discharge INCREMENT of Niagara River per foot Rise of Lake Level.	Change in Outflow of Niagara River,	Regulated Conditions, Stage of Lake Erie,
	First of Month.	Mean of Month.	In Feet.	100 c.f.s.	Foot Depth	Foot Depth	Foot Depth	Rise or Fall in Stage of Lake Erie during month in Feet.	Stage of Lake Erie, First of Month.	First of Month.	Mean of Month.	100 c.f.s.	100 c.f.s.	Mean of Month.
1888														
May		572·98												
June	573·04	3·11	+0·14	− 6	−0·0051	0·0000	−0·0051	+0·135	573·040	0·000	−0·002	251	− 1	573·108
July	3·18	3·26	+0·03	−20	−0·0198	+0·0010	−0·0159	+0·014	3·175	−0·005	−0·013	251	− 3	3·247
Aug.	3·21	3·16	−0·27	−33	−0·0279	+0·0040	−0·0239	−0·294	3·189	−0·021	−0·033	251	− 8	3·127
Sept.	2·94	2·72	−0·40	−42	−0·0358	+0·0081	−0·0277	−0·428	2·895	−0·045	−0·059	232	−14	2·661
Oct.	2·54	2·35	−0·16	−52	−0·0443	+0·0131	−0·0312	−0·191	2·467	−0·073	−0·088	232	−20	2·262
Nov.	2·38	2·41	−0·03	−61	−0·0520	+0·0187	−0·0333	−0·063	2·276	−0·104	−0·120	232	−28	2·290
Dec.	2·35	2·29	−0·05	−67	−0·0571	+0·0247	−0·0324	−0·082	2·213	−0·137	−0·153	232	−35	2·137
1889														
Jan.	2·30	2·31	−0·07	−62	−0·0529	+0·0304	−0·0225	−0·092	2·131	−0·169	−0·180	232	−42	2·130
Feb.	2·23	2·15	−0·16	−61	−0·0520	+0·0344	−0·0176	−0·178	2·039	−0·191	−0·200	214	−43	1·950
Mar.	2·07	1·99	+0·09	−59	−0·0507	+0·0351	−0·0156	+0·074	1·861	−0·209	−0·217	214	−46	1·773
Apr.	2·16	2·34	+0·27	−58	−0·0498	+0·0378	−0·0120	+0·258	1·935	−0·225	−0·231	232	−54	2·109
May	2·43	2·52	+0·31	−58	−0·0494	+0·0427	−0·0067	+0·303	2·193	−0·237	−0·240	232	−56	2·280
June	2·74	2·95	+0·31	−66	−0·0563	+0·0439	−0·0124	+0·298	2·496	−0·244	−0·250	232	−58	2·700
July	3·05	3·15	−0·05	−71	−0·0605	+0·0461	−0·0144	−0·064	2·794	−0·256	−0·263	232	−61	2·887
Aug.	3·00	2·84	−0·36	−76	−0·0648	+0·0486	−0·0162	−0·376	2·730	−0·270	−0·278	232	−64	2·562
Sept.	2·64	2·45	−0·40	−82	−0·0699	+0·0515	−0·0184	−0·418	2·354	−0·286	−0·295	232	−68	2·155
Oct.	2·24	2·03	−0·34	−79	−0·0679	+0·0511	−0·0168	−0·357	1·936	−0·304	−0·312	214	−67	1·718
Nov.	1·90	1·76	−0·01	−82	−0·0704	+0·0539	−0·0165	+0·026	1·579	−0·321	−0·329	214	−70	1·431
Dec.	1·89	2·02	+0·31	−82	−0·0704	+0·0566	−0·0138	+0·296	1·553	−0·337	−0·344	214	−74	1·676
1890														
Jan.	2·20	2·38	+0·32	−81	−0·0696	+0·0590	−0·0106	+0·309	1·849	−0·351	−0·356	232	−83	2·024
Feb.	2·52	2·67	+0·21	−78	−0·0665	+0·0652	−0·0013	+0·209	2·158	−0·362	−0·362	232	−84	2·308
Mar.	2·73	2·79	+0·31	−73	−0·0622	+0·0653	+0·0031	+0·313	2·367	−0·363	−0·362	232	−84	2·428
Apr.	3·04	3·28	+0·41	−69	−0·0588	+0·0648	+0·0060	+0·416	2·680	−0·360	−0·357	232	−83	2·923
May	3·45	3·62	+0·35	−65	−0·0549	+0·0680	+0·0131	+0·363	3,096	−0·354	−0·348	251	−87	3·272
June	3·80	3·99	0·00	−66	−0·0558	+0·0655	+0·0097	+0·010	3·459	−0·341	−0·336	251	−84	3·654
July	3·80	3·61	−0·42	−76	−0·0642	+0·0636	+0·0006	−0·421	3·469	−0·331	−0·332	251	−83	3·278
Aug.	3·38	3·15	−0·32	−81	−0·0685	+0·0637	−0·0048	−0·325	3·048	−0·332	−0·334	232	−77	2·816
Sept.	3·06	2·98	−0·18	−85	−0·0725	+0·0607	−0·0118	−0·192	2·723	−0·337	−0·343	232	−80	2·637

Oct.	2·88	2·79	−0·10	−81	−0·0691	+0·0628	−0·0063	−0·106	2·531	−0·349	−0·352	232	−82	2·438
Nov.	2·78	2·76	−0·14	−83	−0·0708	+0·0639	−0·0069	−0·147	2·425	−0·355	−0·358	232	−83	2·402
Dec.	2·64	2·53	−0·22	−84	−0·0716	+0·0652	−0·0064	−0·226	2·278	−0·362	−0·365	232	−85	2·165
1891														
Jan	572·42	572·31	−0·12	−81	−0·0691	+0·0662	−0·0029	−0·123	572·052	−0·368	−0·370	214	−79	571·940
Feb.	2·30	2·29	+0·22	−71	−0·0610	+0·0623	+0·0013	+0·221	1·929	−0·371	−0·370	214	−79	1·920
Mar.	2·52	2·75	+0·16	−67	−0·0571	+0·0666	+0·0095	+0·170	2·150	−0·370	−0·365	232	−85	2·385
Apr.	2·68	2·62	−0·15	−67	−0·0571	+0·0648	+0·0077	−0·142	2·320	−0·360	−0·356	232	−83	2·264
May	2·53	2·44	−0·02	−65	−0·0554	+0·0634	+0·0080	−0·012	2·178	−0·352	−0·348	232	−81	2·092
June	2·51	2·58	+0·02	−64	−0·0546	+0·0619	+0·0073	+0·027	2·166	−0·344	−0·340	232	−79	2·240
July	2·53	2·48	−0·19	−63	−0·0537	+0·0607	+0·0070	−0·183	2·193	−0·337	−0·334	232	−77	2·146
Aug.	2·34	2·21	−0·22	−63	−0·0537	+0·0594	+0·0057	−0·214	2·010	−0·330	−0·327	214	−70	1·883
Sept	2·12	2·03	−0·28	−63	−0·0541	+0·0544	+0·0003	−0·280	1·796	−0·324	−0·324	214	−69	1·706
Oct.	1·84	1·65	−0·41	−62	−0·0533	+0·0544	+0·0011	−0·409	1·516	−0·324	−0·324	214	−69	1·326
Nov	1·43	1·21	−0·19	−58	−0·0498	+0·0543	+0·0045	−0·186	1·107	−0·323	−0·321	196	−63	0·889
Dec.	1·24	1·28	+0·06	−56	−0·0485	+0·0501	+0·0016	+0·062	0·921	−0·319	−0·318	196	−62	0·962
1892														
Jan.	1·30	1·31	−0·10	−53	−0·0459	+0·0498	+0·0039	−0·096	0·983	−0·317	−0·315	196	−62	0·995
Feb.	1·20	1·10	−0·08	−49	−0·0424	+0·0491	+0·0067	−0·073	0·887	−0·313	−0·310	196	−61	0·790
Mar.	1·12	1·14	+0·30	−43	−0·0372	+0·0480	+0·0108	+0·311	0·814	−0·306	−0·300	196	−59	0·840
Apr.	1·42	1·70	+0·68	−37	−0·0318	+0·0496	+0·0178	+0·698	1·125	−0·295	−0·286	214	−61	1·414
May	2·10	2·50	+0·78	−34	−0·0292	+0·0465	+0·0173	+0·797	1·823	−0·277	−9·268	232	−62	2·232
June	2·88	3·26	+0·44	−36	−0·0307	+0·0468	+0·0161	+0·456	2·620	−0·260	−0·252	251	−63	3·008
July	3·32	3·38	−0·12	−38	−0·0321	+0·0468	+0·0147	−0·105	3·076	−0·244	−0·236	251	−59	3·144
Aug.	3·20	3·03	−0·33	−39	−0·0332	+0·0412	+0·0080	−0·322	2·971	−0·229	−0·225	232	−52	2·805
Sept.	2·78	2·71	−0·44	−42	−0·0358	+0·0398	−0·0040	−0·436	2·649	−0·221	−0·219	232	−51	2·491
Oct.	2·43	2·15	−0·45	−43	−0·0367	+0·0391	+0·0024	−0·448	2·213	−0·217	−9·216	214	−46	1·934
Nov.	1·98	1·82	−0·30	−44	−0·0378	+0·0361	−0·0017	−0·302	1·765	−0·215	−0·216	214	−46	1·604
Dec.	1·68	1·55	−0·32	−39	−0·0335	+0·0365	−0·0030	−0·317	1·463	−0·217	−0·216	214	−46	1·334
1893														
Jan.	1·36	1·17	−0·15	−35	−0·0301	+0·0360	+0·0059	−0·144	1·146	−0·214	−0·211	196	−41	0·959
Feb.	1·21	1·25	+0·15	−29	−0·0249	+0·0349	+0·0100	+0·160	1·002	−0·208	−0·203	214	−43	1·047
Mar.	1·36	1·47	+0·48	−22	−0·0189	+0·0333	+0·0144	+0·494	1·162	−0·198	−0·191	214	−41	1·279
Apr	1·84	2·20	+0·78	−18	−0·0155	+0·0309	+0·0154	+0·795	1·656	−0·184	−0·176	232	−41	2·024
May	2·62	3·04	+0·52	−14	−0·0119	+0·0304	+0·0185	+0·538	2·451	−0·169	−0·160	232	−37	2·880
June	3·14	3·23	−0·05	−15	−0·0128	+0·0272	+0·0144	−0·036	2·989	−0·151	−0·144	251	−36	3·086
July.	3·09	2·95	−0·31	−18	−0·0153	+0·0247	+0·0094	−0·301	2·953	−0·137	−0·132	232	−31	2·818
Aug.	2·78	2·61	−0·36	−24	−0·0205	+0·0230	+0·0025	−0·358	2·652	−0·128	−0·127	232	−29	2·483
Sept.	2·42	2·23	−0·36						2·294	−0·126				

TABLE 42.

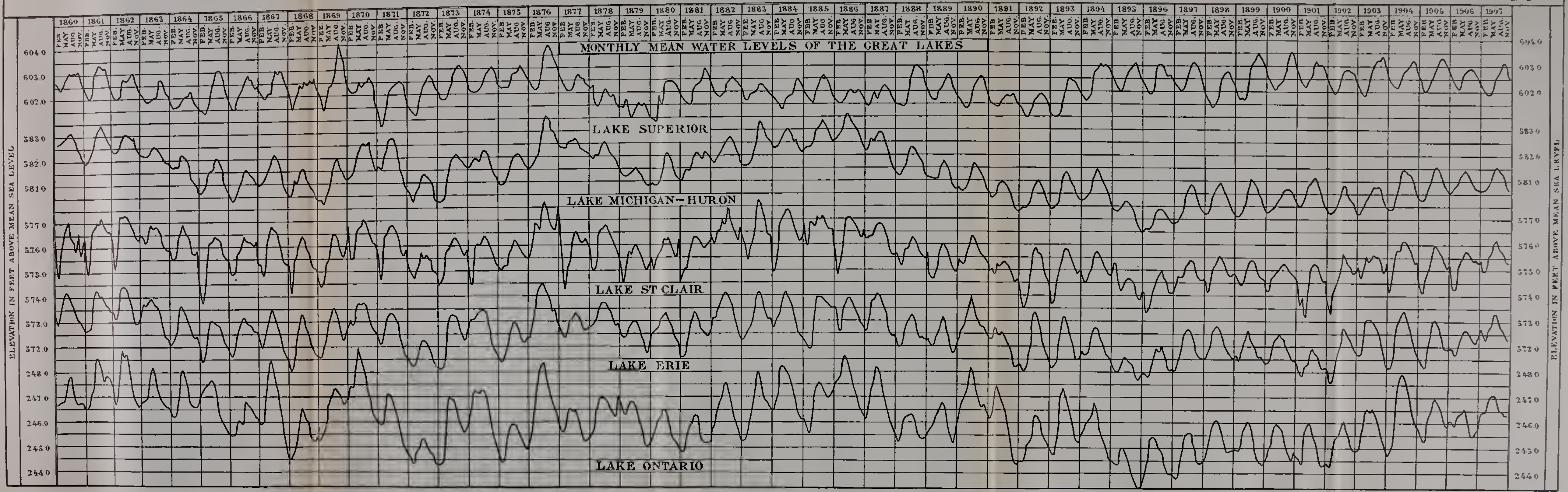
EFFECT ON WATER LEVELS OF LAKE ONTARIO, BY REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSION OF 4,000 CUBIC FEET PER SECOND THROUGH CHICAGO DRAINAGE CANAL.

Date.	WATER LEVELS OF LAKE ONTARIO AT OSWEGO, N.Y.		Rise or Fall in Stage of Lake Ontario During Month, in Feet	Net Change in Transmitted Supply 100 c. f. s.	Effect of Net Change in Transmitted Supply on Stage of Lake Ontario, Foot Depth	Effect of Change in Outflow through St. Lawrence River on Stage of Lake Ontario, Foot Depth	Total Effect, Net Change in Transmitted Supply and Outflow, on Stage of Lake Ontario, Foot Depth	REGULATED CONDITIONS.		REGULATED STAGE, LESS ACTUAL STAGE OF LAKE ONTARIO.		Regulated Conditions, Stage of Lake Ontario. Mean of Month.
	First of Month.	Mean of Month.						Rise or Fall in Stage of Lake Ontario During Month, in Feet.	Stage of Lake Ontario, First of Month.	First of Month.	Mean of Month.	
1888												
May......		246·24										
June......	246·26	6·28	+0·05	− 1	−0·0011	−0·0000	−0·0011	+0·049	246·260	0·000	0·000	246·280
July......	6·31	6·34	−0·02	− 3	−0·0033	+0·0003	−0·0030	−0·023	6·309	−0·001	−0·002	6·338
Aug......	6·29	6·24	−0·25	− 8	−0·0088	+0·0013	−0·0075	−0·258	6·286	−0·004	−0·008	6·232
Sept.....	6·04	5·85	−0·37	−14	−0·0153	+0·0038	−0·0115	−0·382	6·028	−0·012	−0·018	5·832
Oct.......	5·67	5·49	−0·21	−20	−0·0220	+0·0074	−0·0146	−0·225	5·646	−0·024	−0·032	5·458
Nov......	5·46	5·42	−0·04	−28	−0·0308	+0·0120	−0·0188	−0·059	5·421	−0·039	−0·048	5·372
Dec......	5·42	5·41	+0·10	−35	−0·0385	+0·0179	−0·0206	+0·079	5·362	−0·058	−0·068	5·342
1889												
Jan.......	5·52	5·62	+0·17	−42	−0·0463	+0·0243	−0·0220	+0·148	5·441	−0·079	−0·090	5·530
Feb......	5·69	5·76	+0·15	−43	−0·0474	+0·0311	−0·0163	+0·134	5·589	−0·101	−0·109	5·651
Mar......	5·84	5·93	+0·21	−46	−0·0507	+0·0360	−0·0147	+0·195	5·723	−0·117	−0·124	5·806
Apr......	6·05	6·17	+0·19	−51	−0·0595	+0·0407	−0·0188	+0·171	5·918	−0·132	−0·142	6·028
May......	6·24	6·32	+0·24	−56	−0·0613	+0·0480	−0·0133	+0·227	6·089	−0·151	−0·158	6·162
June......	6·48	6·63	+0·24	−58	−0·0635	+0·0522	−0·0113	+0·229	6·316	−0·164	−0·170	6·460
July......	6·72	6·82	−0·02	−61	−0·0668	+0·0656	−0·0112	−0·031	6·545	−0·175	−0·180	6·640
Aug......	6·70	6·57	−0·41	−64	−0·0701	+0·0591	−0·0110	−0·421	6·514	−0·186	−0·192	6·378
Sept.....	6·29	6·01	−0·50	−68	−0·0745	+0·0626	−0·0119	−0·512	6·093	−0·197	−0·203	5·807
Oct.......	5·79	5·57	−0·42	−67	−0·0738	+0·0644	−0·0094	−0·429	5·581	−0·209	−0·214	5·356
Nov......	5·37	5·17	+0·09	−70	−0·0771	+0·0671	−0·0100	+0·080	5·152	−0·218	−0·223	4·947
Dec......	5·46	5·74	+0·54	−74	−0·0815	+0·0702	−0·0113	+0·529	5·232	−0·228	−0·234	5·506
1890												
Jan.......	6·00	6·25	+0·42	−83	−0·0914	+0·0736	−0·0178	+0·402	5·761	−0·239	−0·248	6·002
Feb......	6·42	6·60	+0·34	−84	−0·0920	+0·0817	−0·0103	+0·330	6·163	−0·257	−0·262	6·338
Mar......	6·76	6·93	+0·29	−84	−0·0920	+0·0849	−0·0071	+0·283	6·493	−0·267	−0·270	6·660
Apr......	7·05	7·17	+0·30	−83	−0·0909	+0·0871	−0·0038	+0·296	6·776	−0·274	−0·276	6·894

May......	7·35	7·53	+0·49	−87	−0·0948	+0·0909	−0·0039	+0·486	7·072	−0·278	−0·280	7·250
June......	7·84	8·16	+0·24	−84	−0·0915	+0·0922	+0·0007	+0·241	7·558	−0·282	−0·282	7·878
July......	8·08	7·99	−0·42	−83	−0·0904	+0·0919	+0·0015	−0·418	7·799	−0·281	−0·280	7·710
Aug......	7·66	7·32	−0·52	−77	−0·0839	+0·0912	+0·0073	−0·513	7·381	−0·279	−0·276	7·044
Sept......	7·14	6·97	−0·34	−80	−0·0876	+0·0865	−0·0011	−0·341	6·868	−0·272	−0·272	6·698
Oct......	6·80	6·64	−0·12	−82	−0·0898	+0·0868	−0·0030	−0·123	6·527	−0·273	−0·274	6·366
Nov......	6·68	6·72	−0·06	−83	−0·0909	+0·0878	−0·0031	−0·063	6·404	−0·276	−0·278	6·442
Dec......	6·62	6·51	−0·27	−85	−0·0931	+0·0887	−0·0044	−0·274	6·341	−0·279	−0·281	6·229
1891												
Jan......	246·35	246·19	−0·03	−79	−0·0865	+0·0900	+0·0035	+0·026	246·067	+0·283	−0·281	245·909
Feb......	6·32	6·45	+0·40	−79	−0·0865	+0·0887	+0·0022	+0·402	6·041	−0·279	−0·278	6·172
Mar......	6·72	6·99	+0·51	−85	−0·0931	+0·0881	−0·0050	+0·505	6·443	6·443	−0·280	−6·710
Apr	7·23	7·47	+0·13	−83	−0·0909	+0·0897	−0·0012	+0·129	6·948	−0·282	−0·282	7·188
May......	7·36	7·25	−0·32	−81	−0·0882	+0·0925	+0·0043	−0·316	7·077	−0·283	−0·281	6·969
June......	7·04	6·83	−0·35	−79	−0·0865	+0·0887	+0·0022	−0·348	6·761	−0·279	−0·278	6·552
July......	6·69	6·55	−0·36	−77	−0·0843	+0·0881	+0·0038	−0·356	6·413	−0·277	−0·275	6·275
Aug......	6·33	6·11	−0·43	−70	−0·0767	+0·0868	+0·0101	−0·420	6·057	−0·273	−0·268	5·842
Sept......	5·90	5·68	−0·54	−69	−0·0760	+0·0810	+0·0050	−0·535	5·637	−0·263	−0·260	5·420
Oct......	5·36	5·04	−0·62	−69	−0·0760	+0·0795	+0·0035	−0·616	5·102	−0·258	−0·256	4·784
Nov......	4·74	4·44	−0·32	−63	−0·0698	+0·0759	+0·0061	−0·314	4·486	−0·254	−0·251	4·189
Dec......	4·42	4·41	+0·04	−62	−0·0687	+0·0742	+0·0055	+0·046	4·172	−0·248	−0·245	4·162
1892												
Jan......	4·46	4·51	+0·04	−62	−0·0687	+0·0724	+0·0037	+0·044	4·218	−0·242	−0·240	4·270
Feb......	4·50	4·48	+0·04	−61	−0·0676	+0·0712	+0·0036	+0·044	4·262	−0·238	−0·236	4·244
Mar......	4·54	4·61	+0·36	−59	−0·0653	+0·0700	+0·0047	+0·365	4·306	−0·234	−0·232	4·378
Apr......	4·90	5·19	+0·32	−61	−0·0676	+0·0685	+0·0009	+0·321	4·671	−0·229	−0·228	4·962
May......	5·22	5·25	+0·31	−62	−0·0687	+0·0682	−0·0005	+0·310	4·992	−0·228	−0·228	5·022
June......	5·53	5·81	+0·53	−63	−0·0694	+0·0702	+0·0008	+0·531	5·302	−0·228	−0·228	5·582
July......	6·06	6·32	+0·22	−59	−0·0650	+0·0699	+0·0049	+0·225	5·833	−0·277	−0·224	6·096
Aug......	6·28	6·24	−0·14	−52	−0·0570	+0·0706	+0·0136	−0·126	6·058	−0·222	−0·215	6·025
Sept......	6·14	6·04	−0·32	−51	−0·0562	+0·0641	+0·0079	−0·312	5·932	−0·208	−0·204	5·836
Oct......	5·82	5·60	−0·36	−46	−0·0507	+0·0616	+0·0109	−0·349	5·620	−0·200	−0·194	5·406
Nov......	5·46	5·33	−0·20	−46	−0·0507	+0·0582	+0·0075	−0·192	5·271	−0·189	−0·185	5·145
Dec......	5·26	5·20	−0·22	−46	−0·0507	+0·0557	+0·0050	+0·215	5·079	−0·181	−0·178	5·022
1893												
Jan......	5·04	4·87	−0·22	−41	−0·0454	+0·0526	+0·0072	−0·213	4·864	−0·176	−0·172	4·698
Feb......	4·82	4·76	+0·18	−43	−0·0476	+0·0505	+0·0029	+0·183	4·651	−0·169	−0·168	4·592
Mar......	5·00	5·24	+0·62	−41	−0·0454	+0·0496	+0·0042	+0·624	4·834	−0·166	−0·164	5·076
Apr......	5·62	5·99	+0·95	−41	−0·0452	+0·0499	+0·0047	+0·955	5·458	−0·162	−0·160	5·830
May......	6·57	7·15	+0·69	−37	−0·0405	+0·0499	+0·0094	+0·699	6·413	−0·157	−0·152	6·998
June......	7·26	7·37	−0·02	−36	−0·0392	+0·0484	+0·0092	−0·011	7·112	−0·148	−0·144	7·226
July......	7·24	7·11	−0·40	−31	−0·0338	+0·0455	+0·0117	−0·388	7·101	−0·139	−0·133	6·977
Aug......	6·84	6·57	−0·40	−29	−0·0318	+0·0404	+0·0086	−0·391	6·713	−0·127		

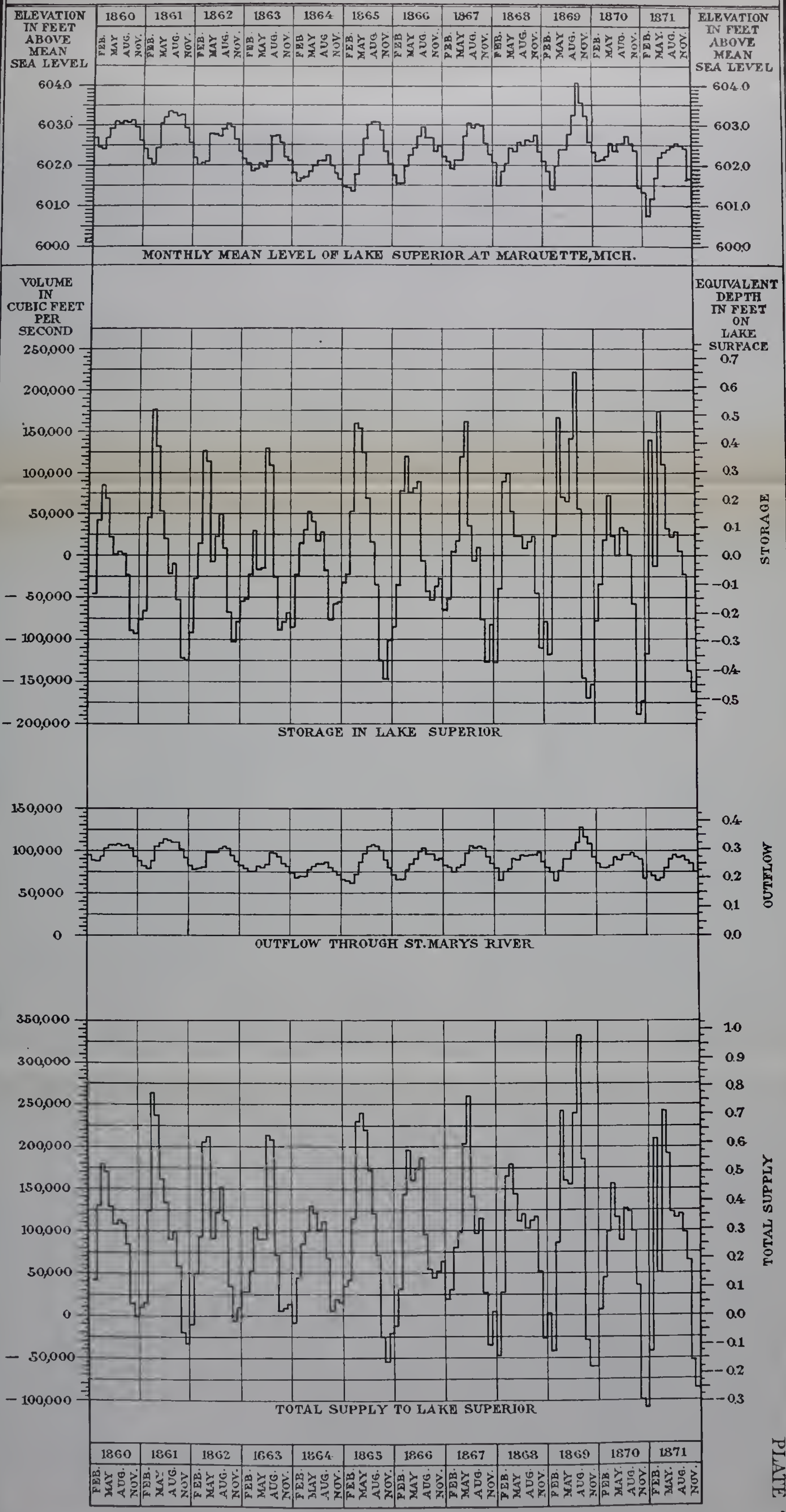
INTERNATIONAL WATERWAYS COMMISSION

PLATE 1



INTERNATIONAL WATERWAYS COMMISSION

PLATE 2



MONTHLY MEAN LEVEL OF LAKE SUPERIOR AT MARQUETTE, MICH.

STORAGE IN LAKE SUPERIOR

OUTFLOW THROUGH ST. MARYS RIVER

TOTAL SUPPLY TO LAKE SUPERIOR

PLATE 2

INTERNATIONAL WATERWAYS COMMISSION PLATE 3

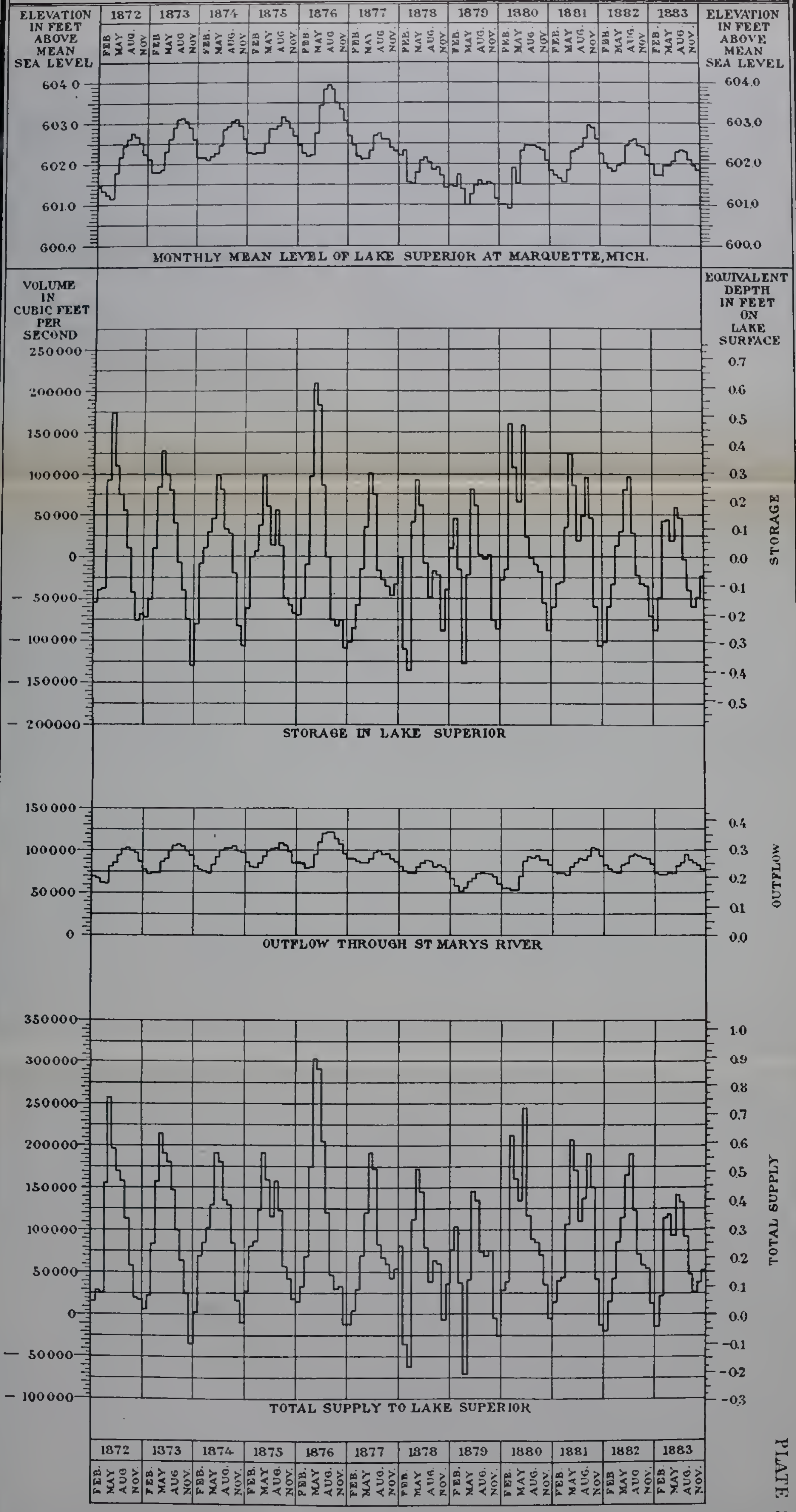
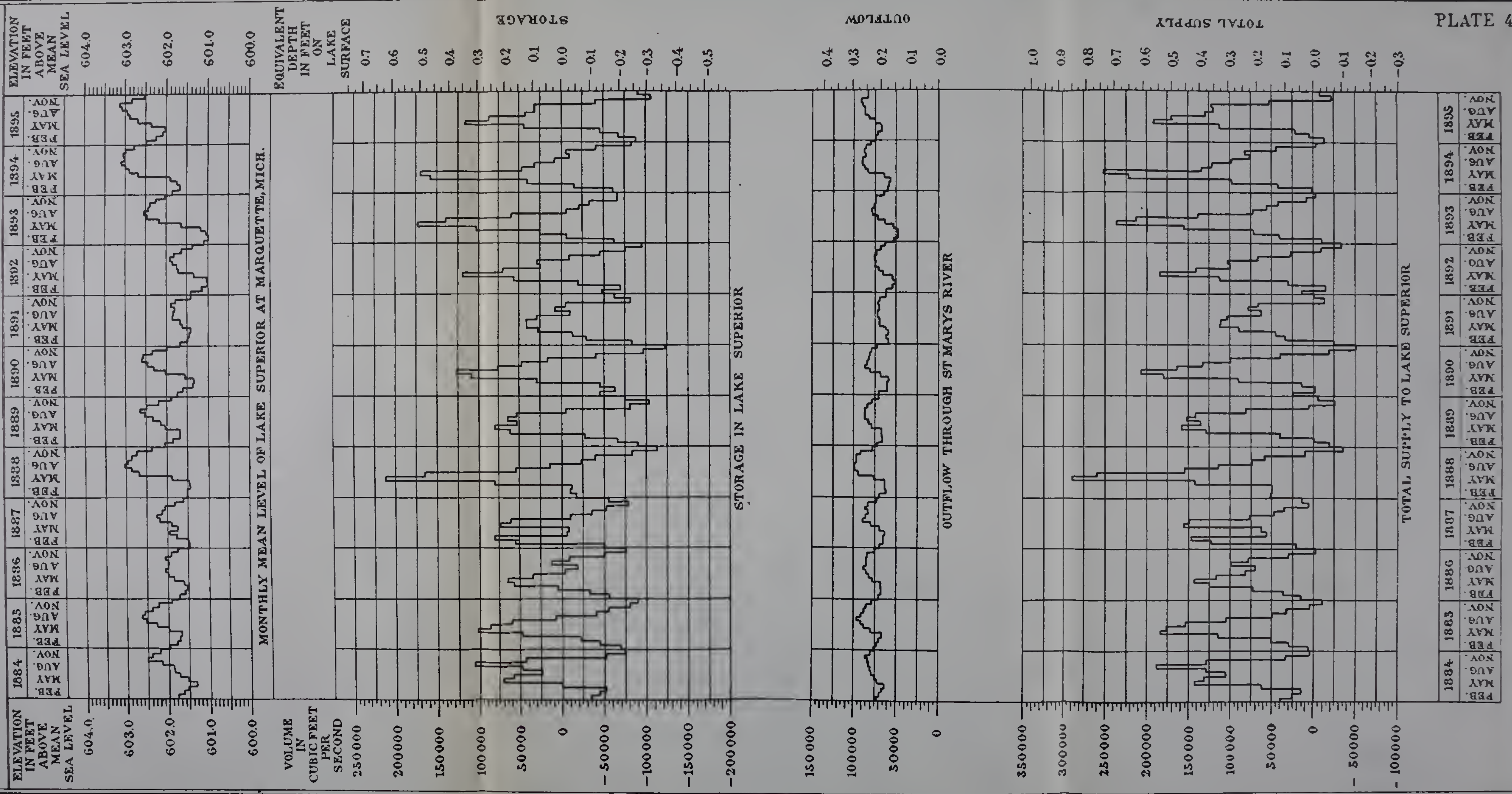


PLATE 3

INTERNATIONAL WATERWAYS COMMISSION

PLATE 4



INTERNATIONAL WATERWAYS COMMISSION PLATE 5

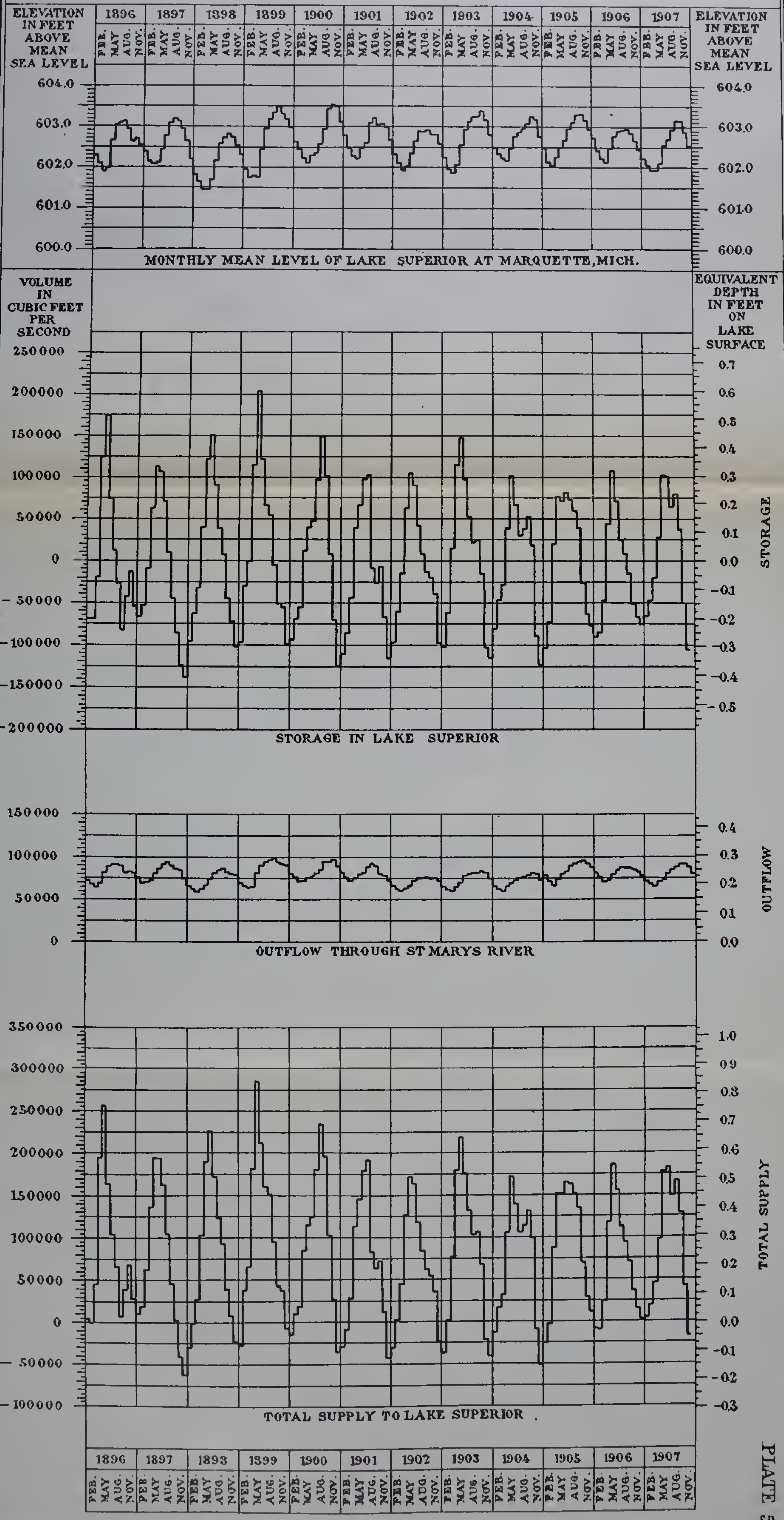
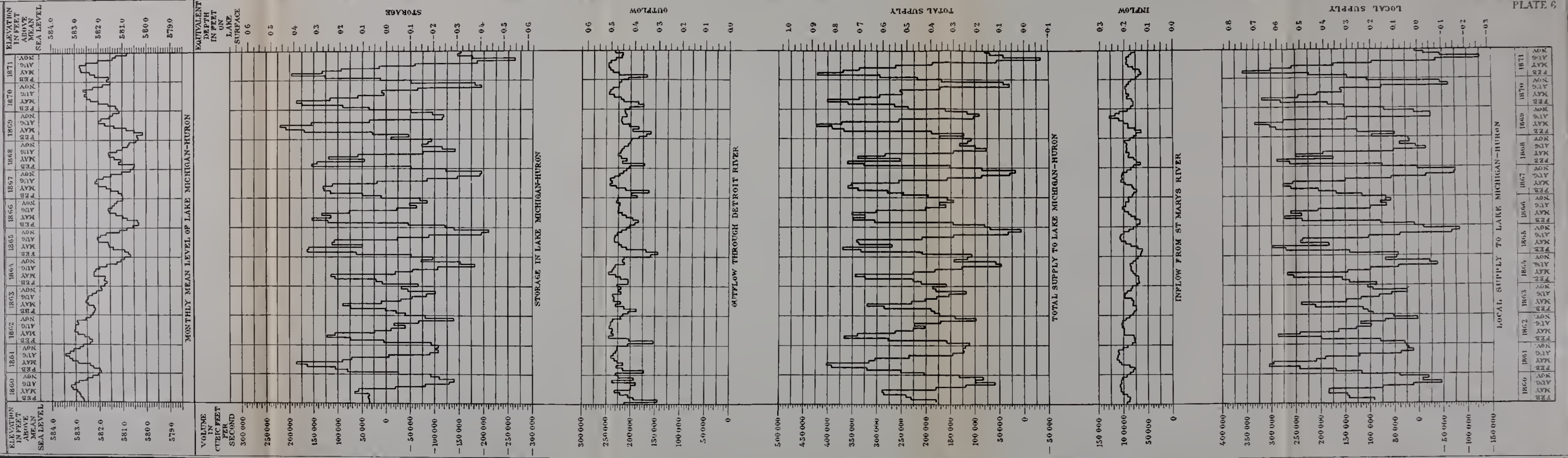


PLATE 5

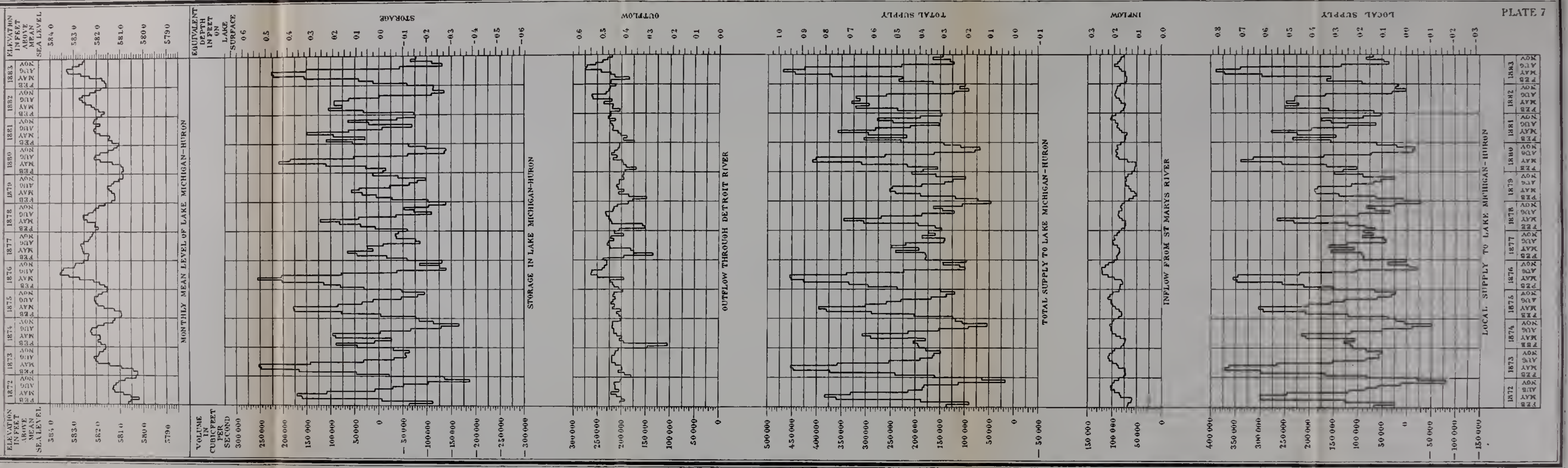
PLATE 6

INTERNATIONAL WATERWAYS COMMISSION



INTERNATIONAL WATERWAYS COMMISSION

PLATE 7



INTERNATIONAL WATERWAYS COMMISSION PLATE 8

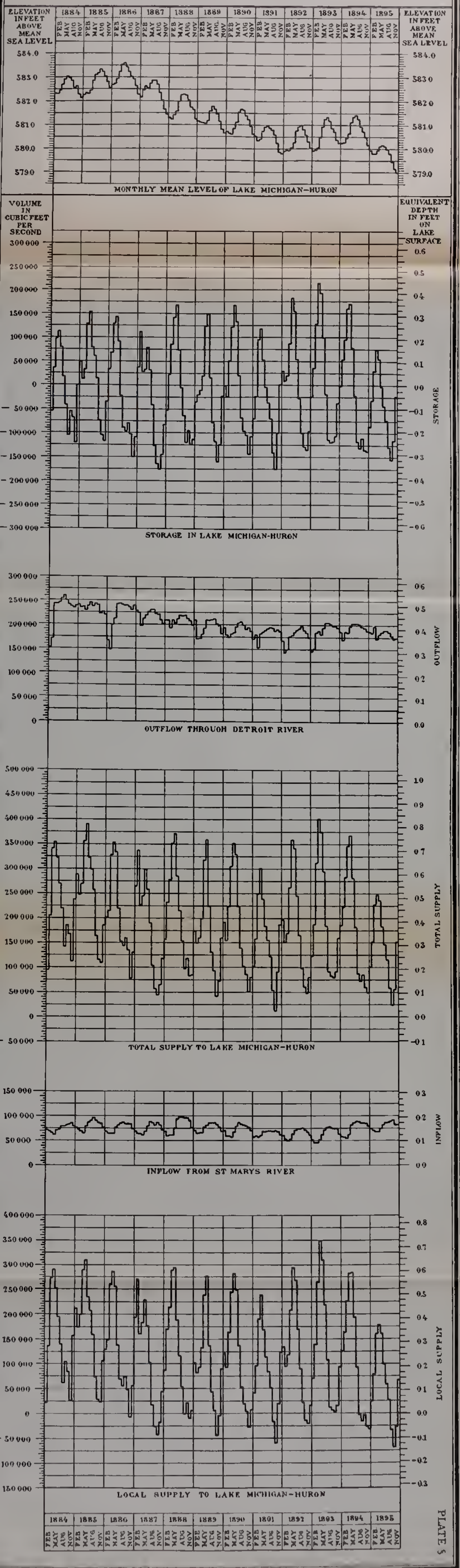


PLATE 8

INTERNATIONAL WATERWAYS COMMISSION PLATE 9

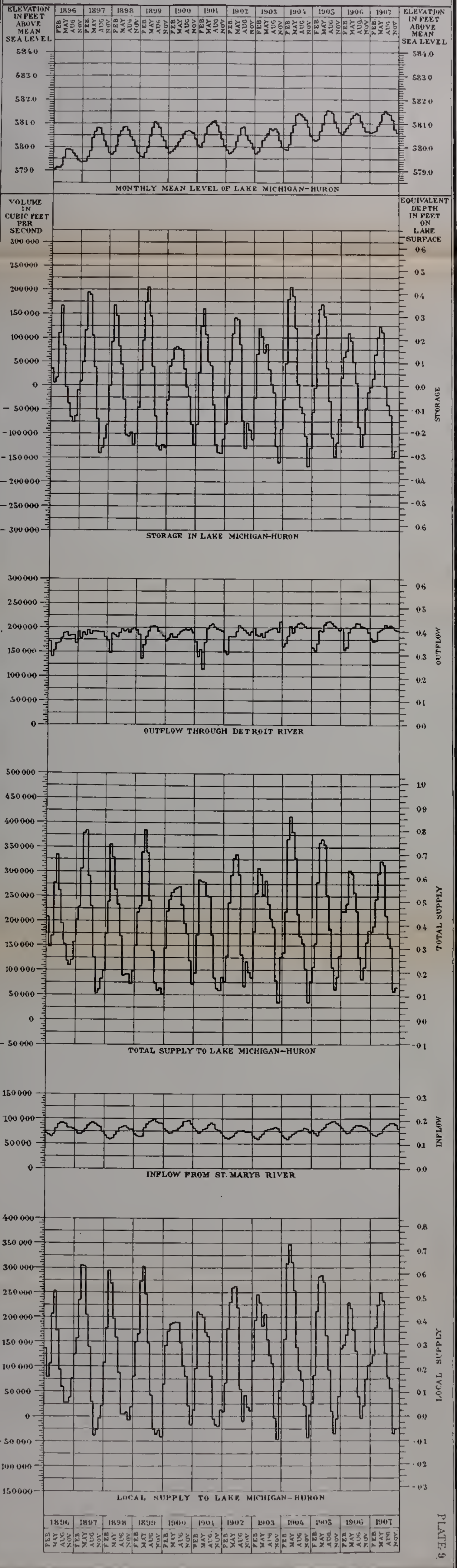
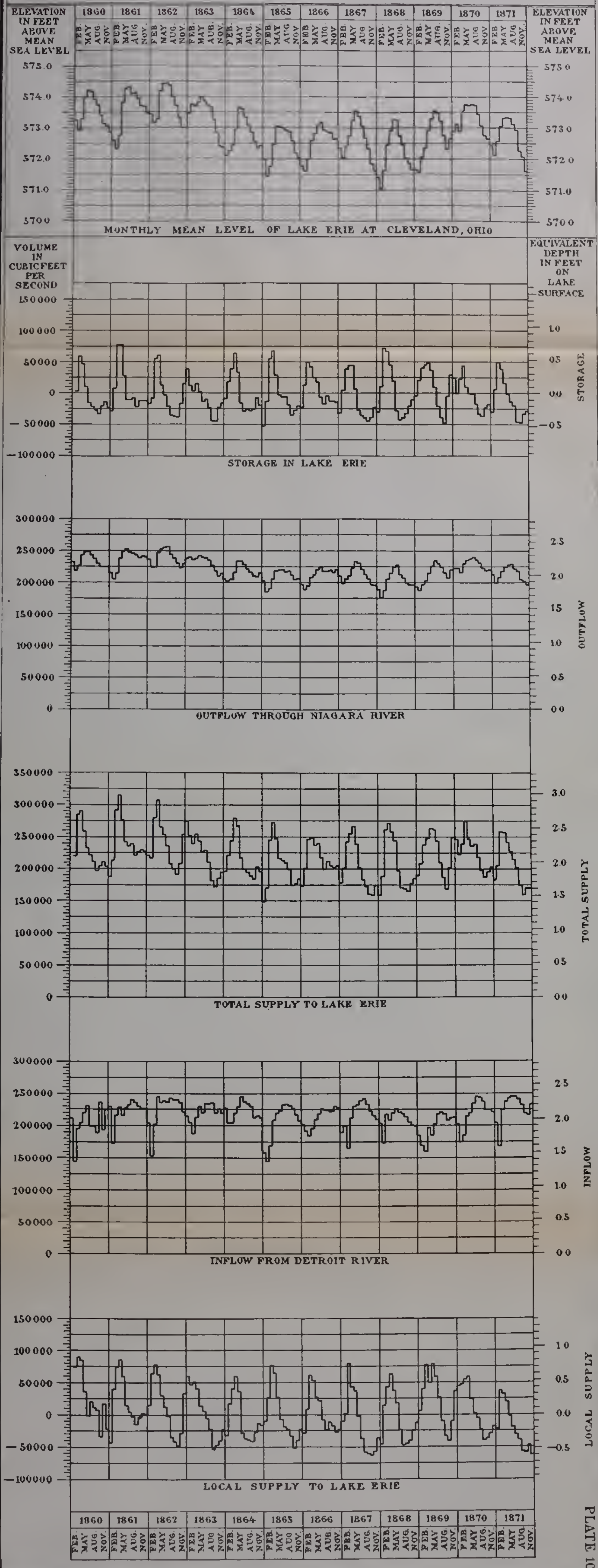
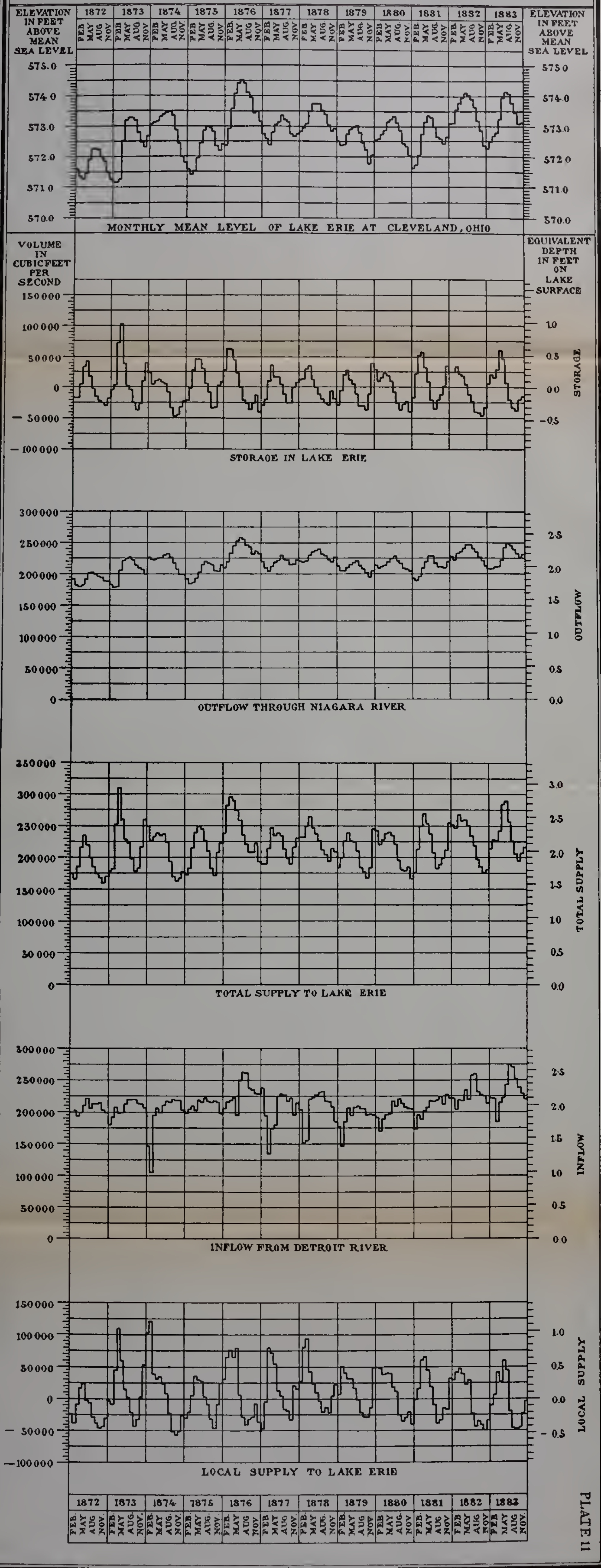


PLATE 9

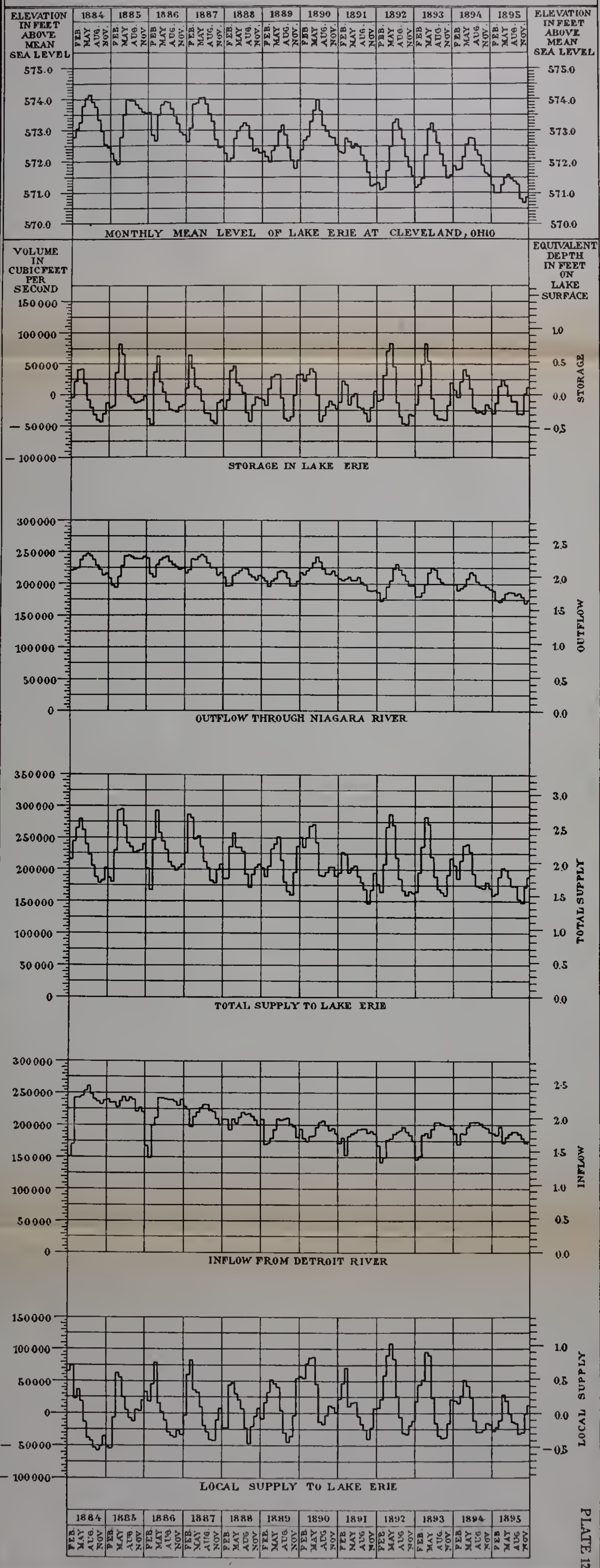
INTERNATIONAL WATERWAYS COMMISSION PLATE 10



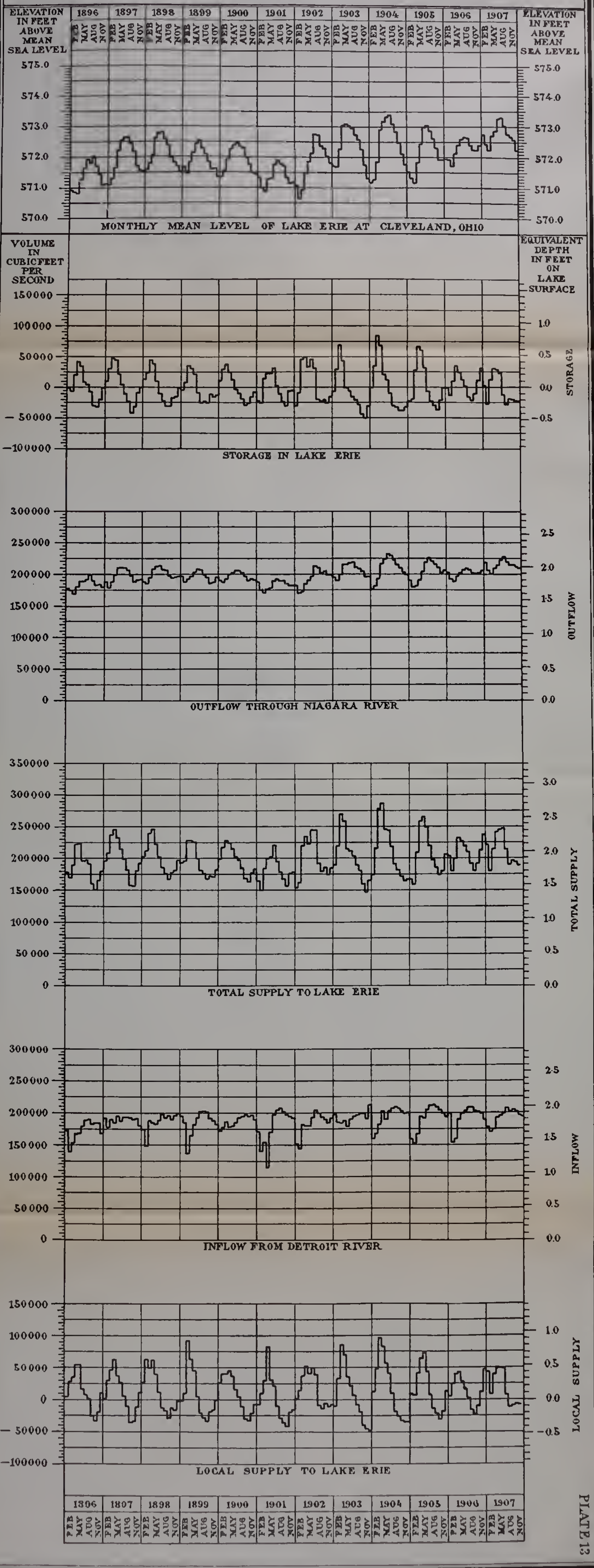
INTERNATIONAL WATERWAYS COMMISSION PLATE 11



INTERNATIONAL WATERWAYS COMMISSION PLATE 12



INTERNATIONAL WATERWAYS COMMISSION PLATE 13


MONTHLY MEAN LEVEL OF LAKE ERIE AT CLEVELAND, OHIO

STORAGE IN LAKE ERIE

OUTFLOW THROUGH NIAGARA RIVER

TOTAL SUPPLY TO LAKE ERIE

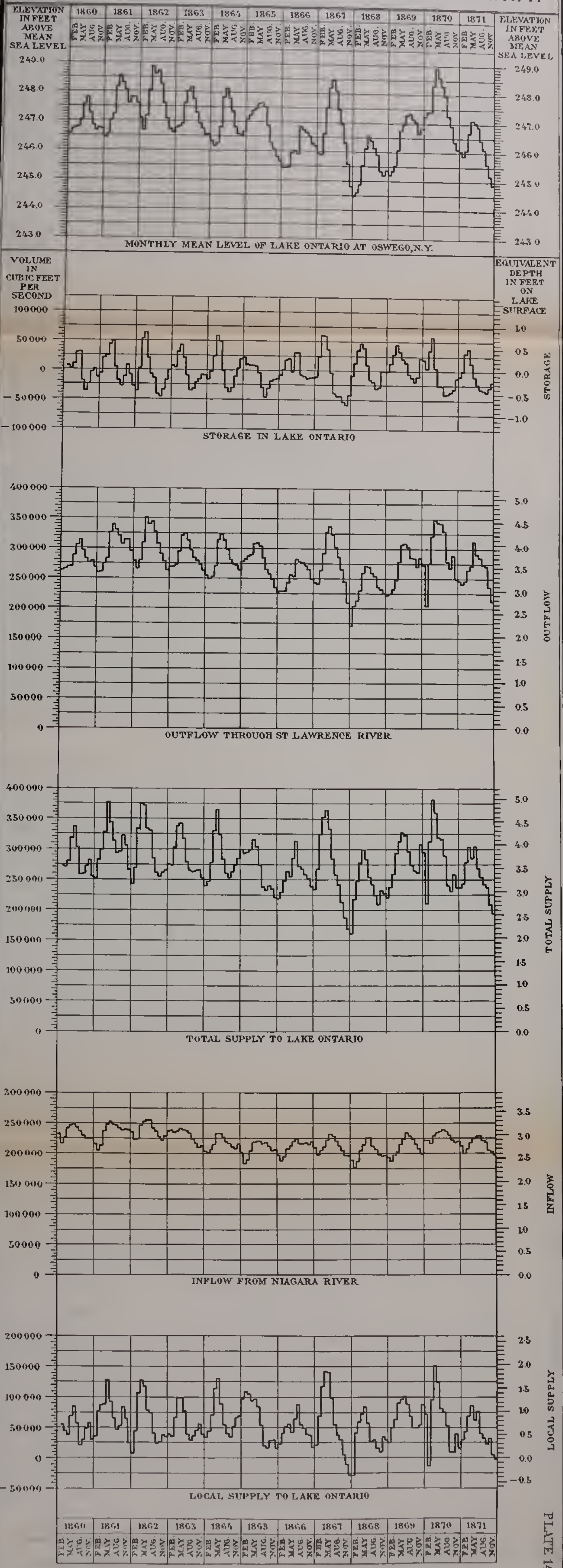
INFLOW FROM DETROIT RIVER

LOCAL SUPPLY TO LAKE ERIE

PLATE 13

INTERNATIONAL WATERWAYS COMMISSION

PLATE 14



MONTHLY MEAN LEVEL OF LAKE ONTARIO AT OSWEGO, N.Y.

STORAGE IN LAKE ONTARIO

OUTFLOW THROUGH ST LAWRENCE RIVER

TOTAL SUPPLY TO LAKE ONTARIO

INFLOW FROM NIAGARA RIVER

LOCAL SUPPLY TO LAKE ONTARIO

INTERNATIONAL WATERWAYS COMMISSION PLATE 15

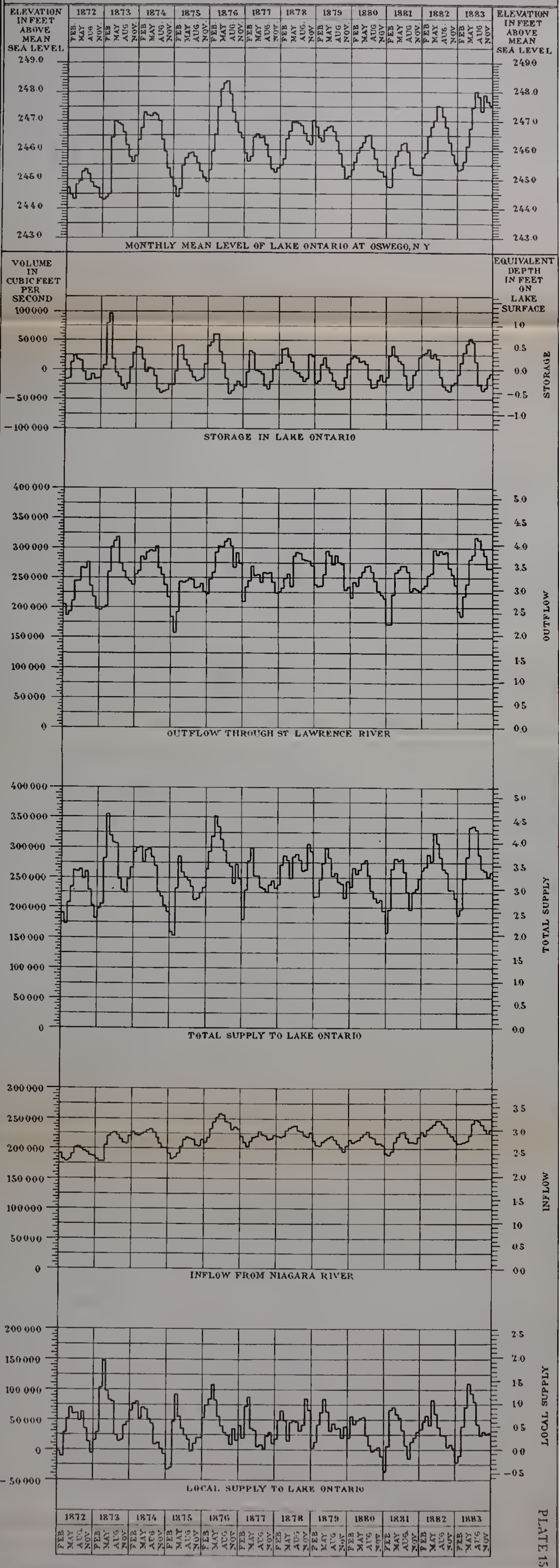
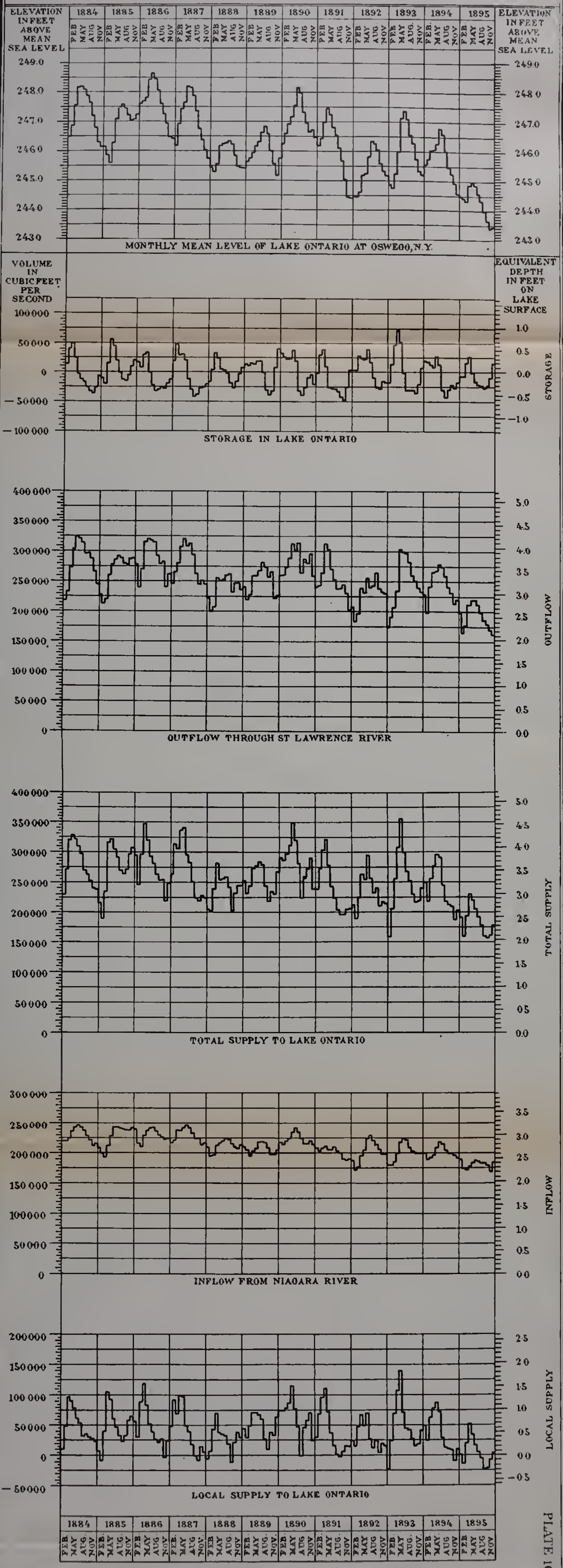


PLATE 15

INTERNATIONAL WATERWAYS COMMISSION PLATE 16



INTERNATIONAL WATERWAYS COMMISSION PLATE 17

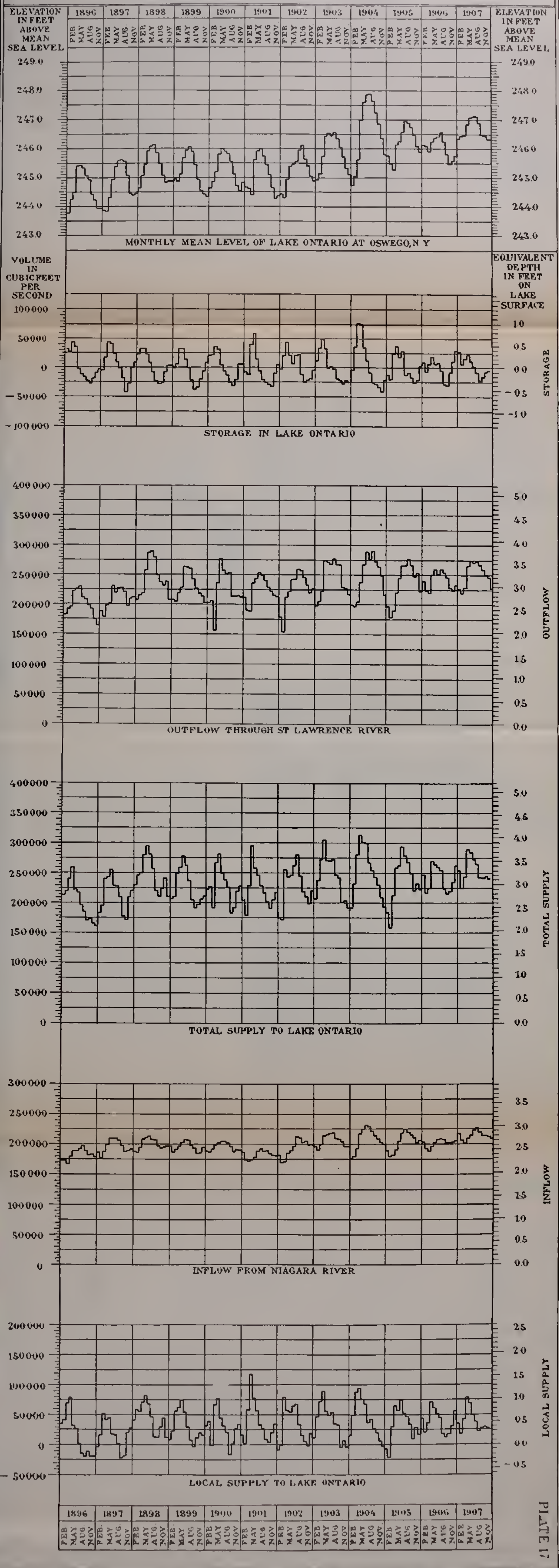


PLATE 17

PLATE 18

INTERNATIONAL WATERWAYS COMMISSION PLATE 18

MEAN MONTHLY SUPPLY FACTORS OF THE GREAT LAKES 1860-1907

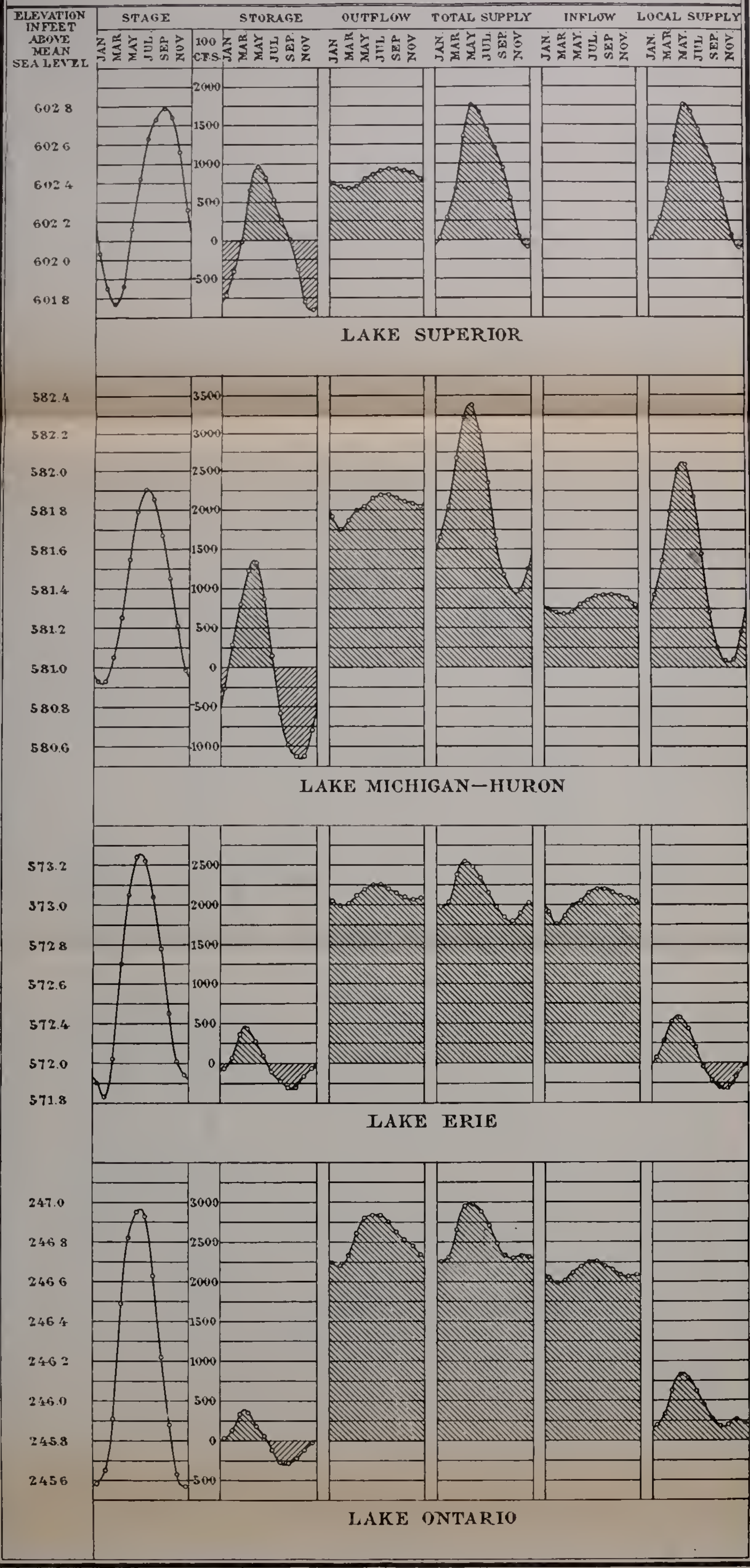
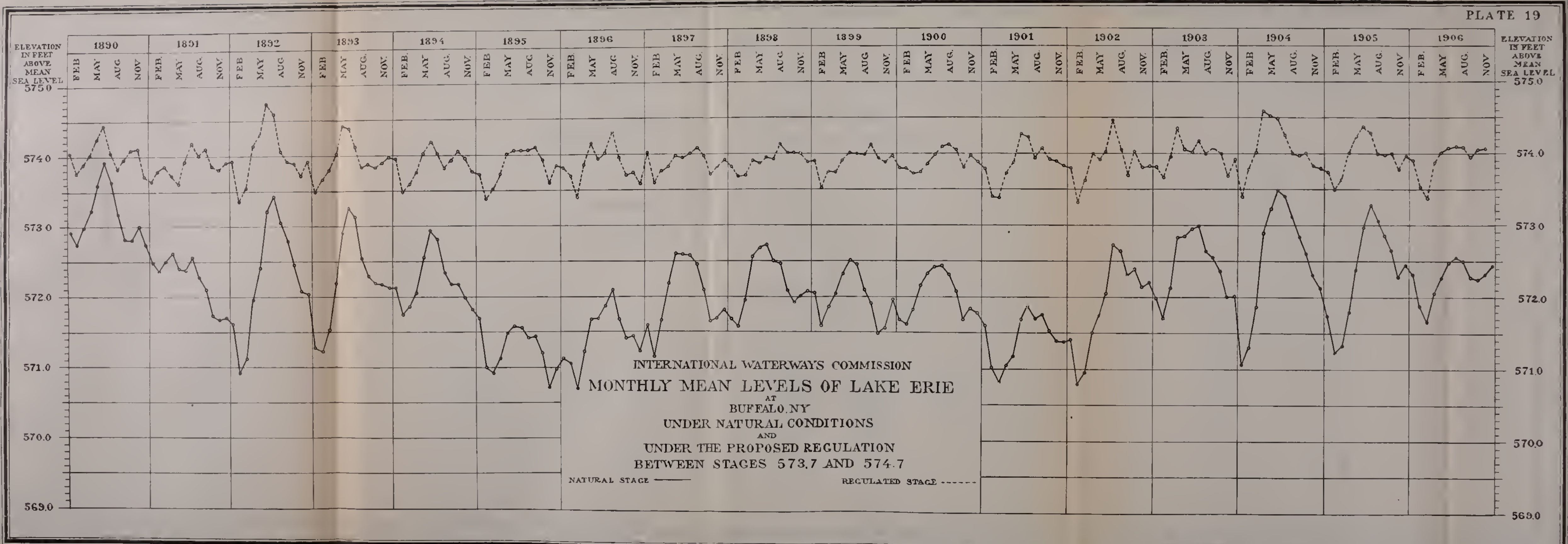


PLATE 19



INTERNATIONAL WATERWAYS COMMISSION

MONTHLY MEAN LEVELS OF LAKE ERIE

AT

BUFFALO, NY

UNDER NATURAL CONDITIONS

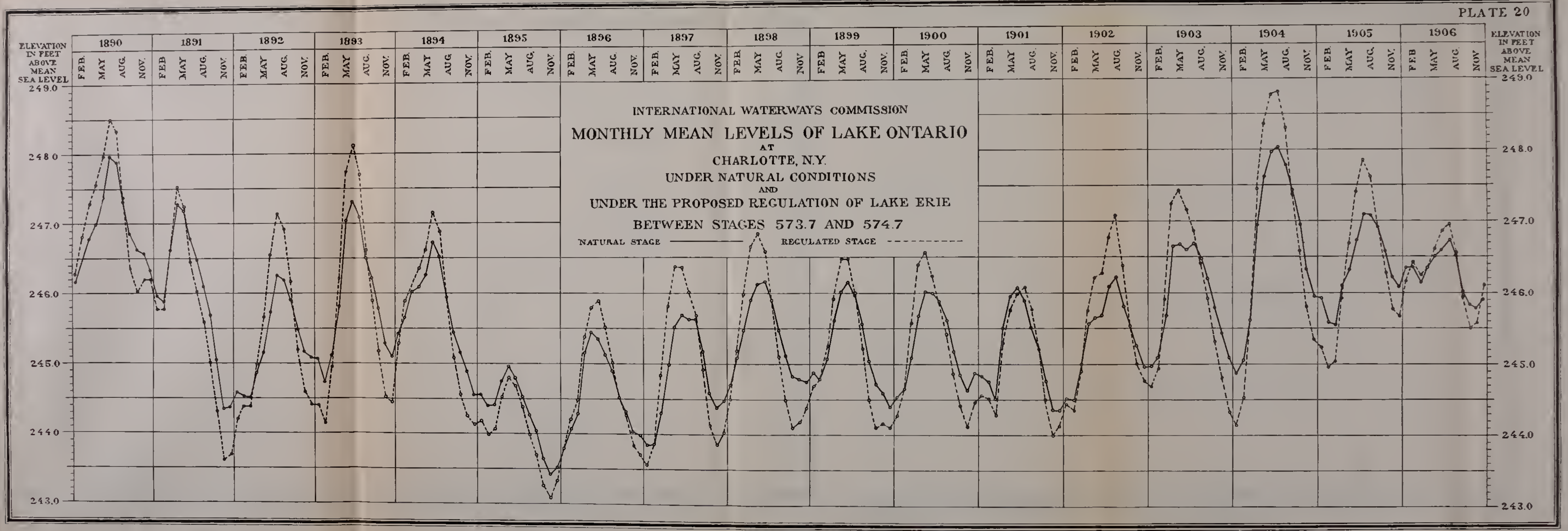
AND

UNDER THE PROPOSED REGULATION

BETWEEN STAGES 573.7 AND 574.7

NATURAL STAGE ——— REGULATED STAGE - - - - - -

PLATE 20



INTERNATIONAL WATERWAYS COMMISSION

MONTHLY MEAN LEVELS OF LAKE ONTARIO
AT
CHARLOTTE, N.Y.
UNDER NATURAL CONDITIONS
AND
UNDER THE PROPOSED REGULATION OF LAKE ERIE
BETWEEN STAGES 573.7 AND 574.7

PLATE 21

INTERNATIONAL WATERWAYS COMMISSION

MONTHLY MEAN LEVELS OF LAKES ERIE AND ONTARIO UNDER NATURAL CONDITIONS AND UNDER THE PROPOSED REGULATION OF LAKE ERIE BETWEEN STAGES 572.0 AND 574.5

NATURAL STAGE ————— REGULATED STAGE - - - - - - - - - -

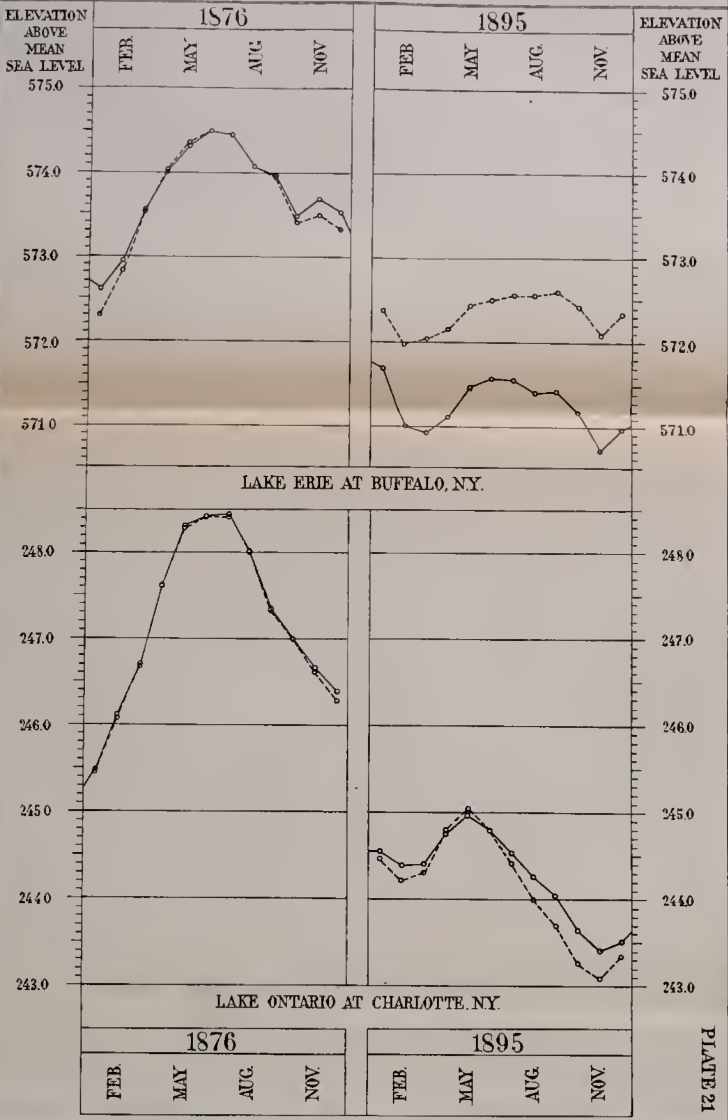
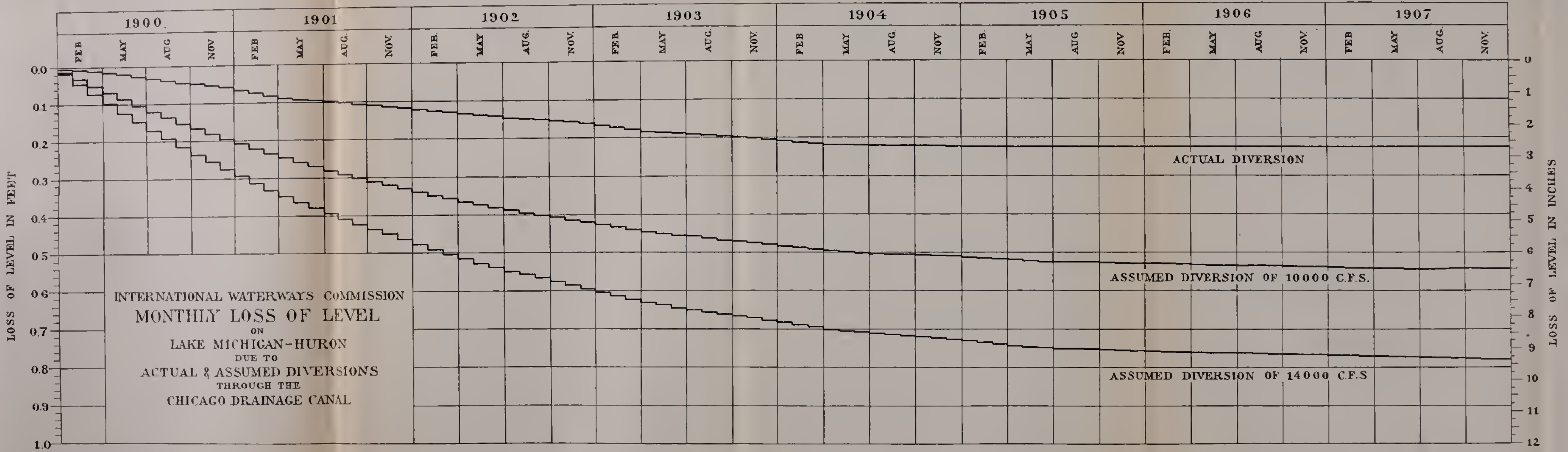


PLATE 21

PLATE 22



INTERNATIONAL WATERWAYS COMMISSION

MONTHLY LOSS OF LEVEL

ON

LAKE MICHIGAN-HURON

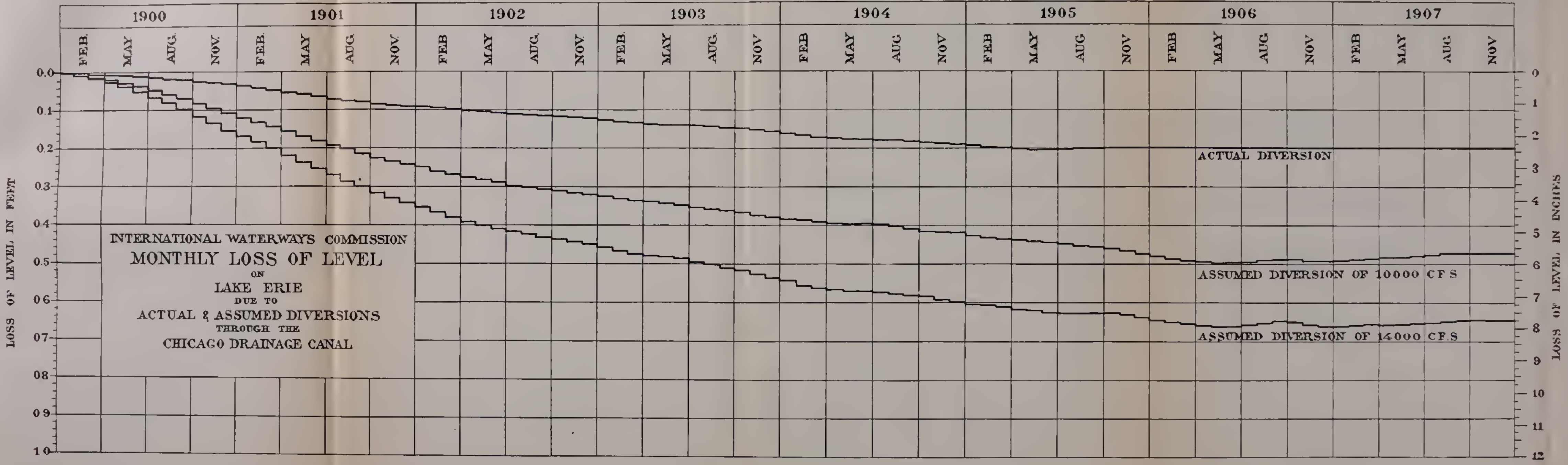
DUE TO

ACTUAL & ASSUMED DIVERSIONS

THROUGH THE

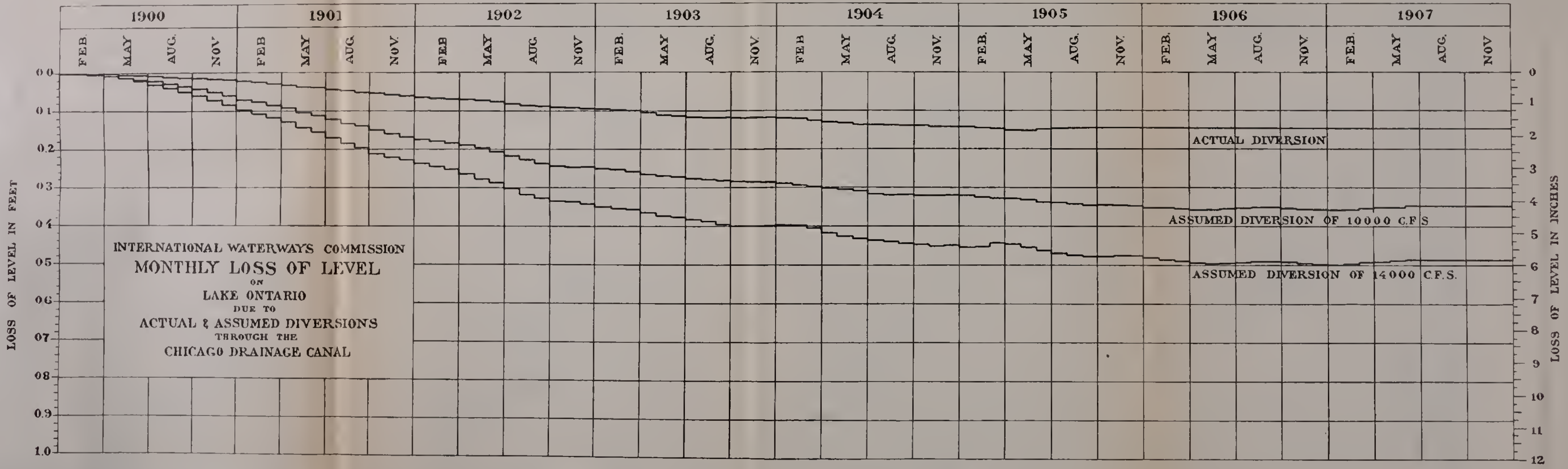
CHICAGO DRAINAGE CANAL

PLATE 23



INTERNATIONAL WATERWAYS COMMISSION
MONTHLY LOSS OF LEVEL
ON
LAKE ERIE
DUE TO
ACTUAL & ASSUMED DIVERSIONS
THROUGH THE
CHICAGO DRAINAGE CANAL

PLATE 24



INTERNATIONAL WATERWAYS COMMISSION

MONTHLY LOSS OF LEVEL

ON

LAKE ONTARIO

DUE TO

ACTUAL & ASSUMED DIVERSIONS

THROUGH THE

CHICAGO DRAINAGE CANAL

INTERNATIONAL WATERWAYS COMMISSION PLATE 25

MONTHLY MEAN WATER LEVELS OF THE GREAT LAKES UNDER THE NATURAL CONDITIONS AND UNDER THE PROPOSED REGULATION OF LAKE SUPERIOR TO COMPENSATE FOR DIVERSIONS THROUGH THE CHICAGO DRAINAGE CANAL OF 4000 & 14000 CUBIC FEET PER SECOND

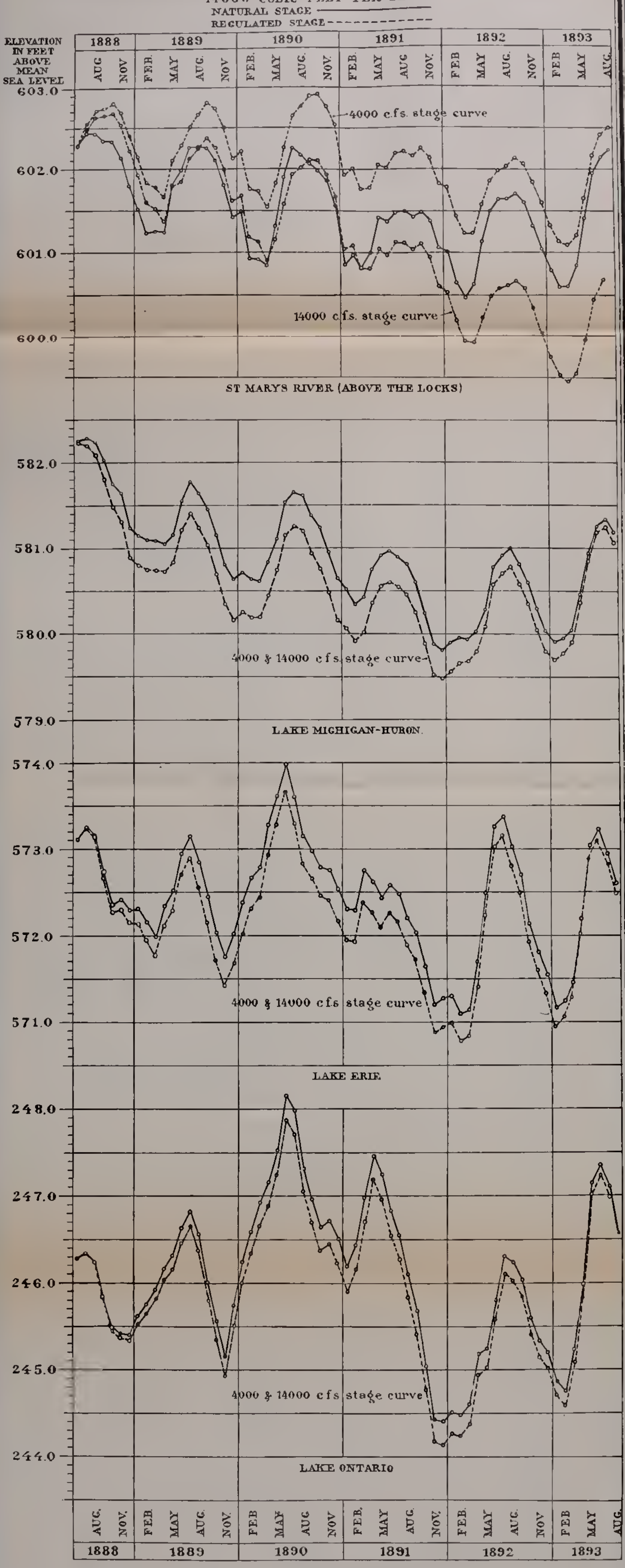
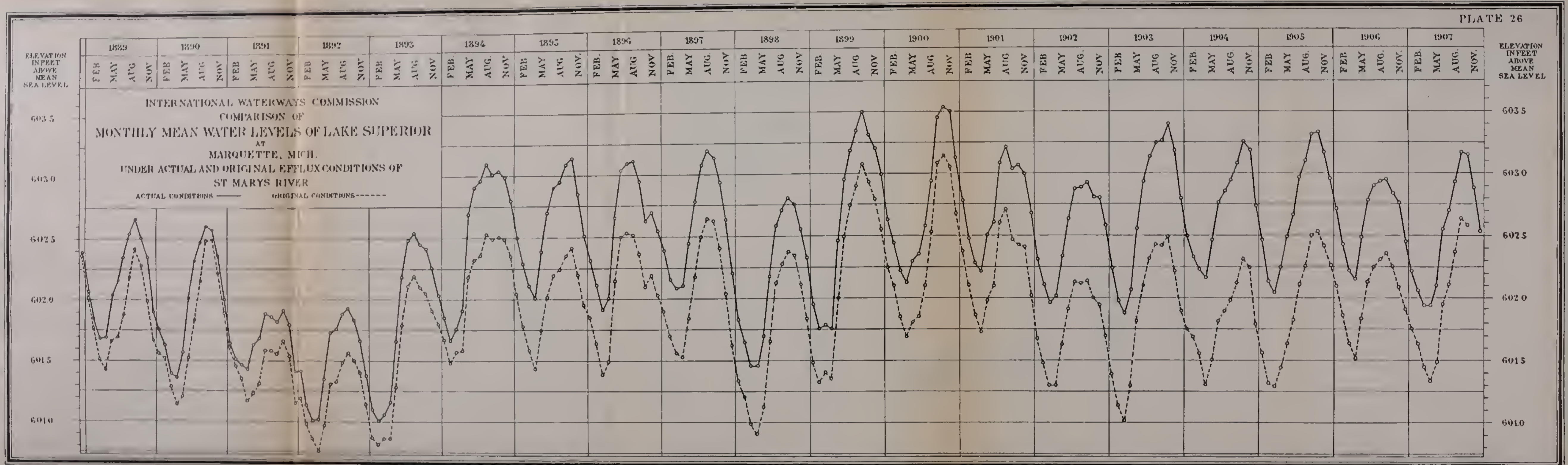
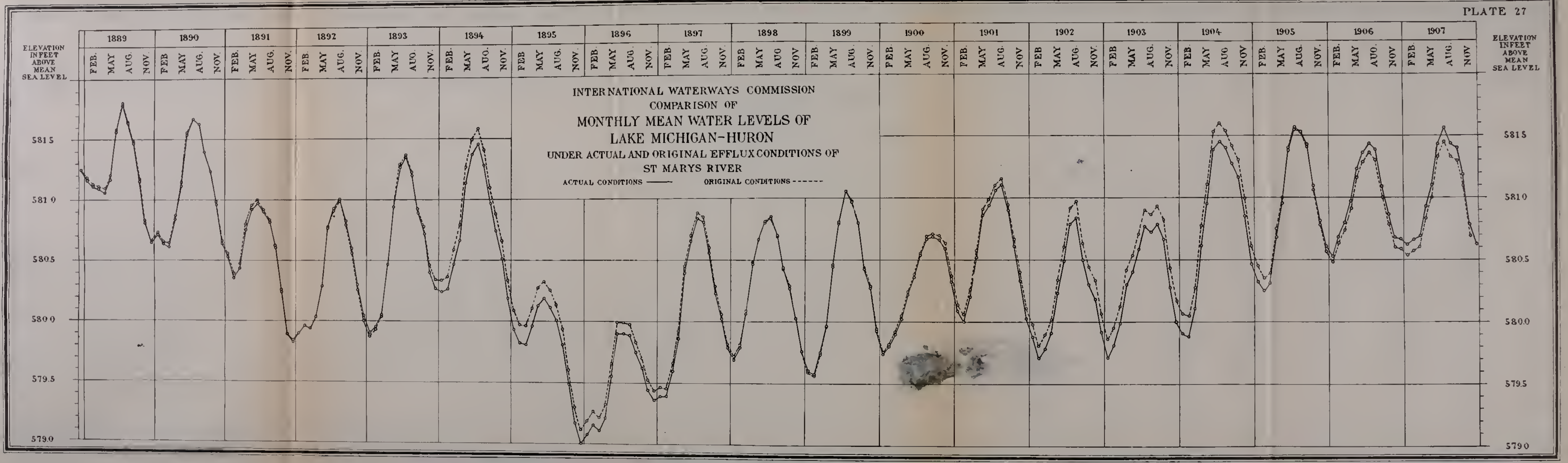


PLATE 26



INTERNATIONAL WATERWAYS COMMISSION
COMPARISON OF
MONTHLY MEAN WATER LEVELS OF LAKE SUPERIOR
AT
MARQUETTE, MICH.
UNDER ACTUAL AND ORIGINAL EFFLUX CONDITIONS OF
ST MARYS RIVER

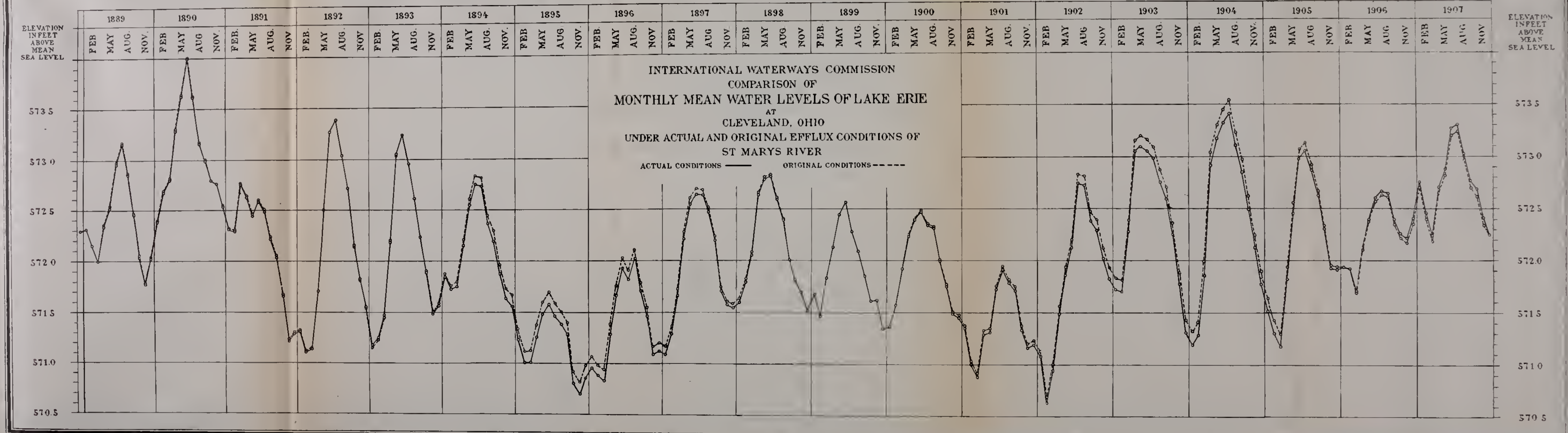
PLATE 27



INTERNATIONAL WATERWAYS COMMISSION
COMPARISON OF
MONTHLY MEAN WATER LEVELS OF
LAKE MICHIGAN-HURON
UNDER ACTUAL AND ORIGINAL EFFLUX CONDITIONS OF
ST MARYS RIVER

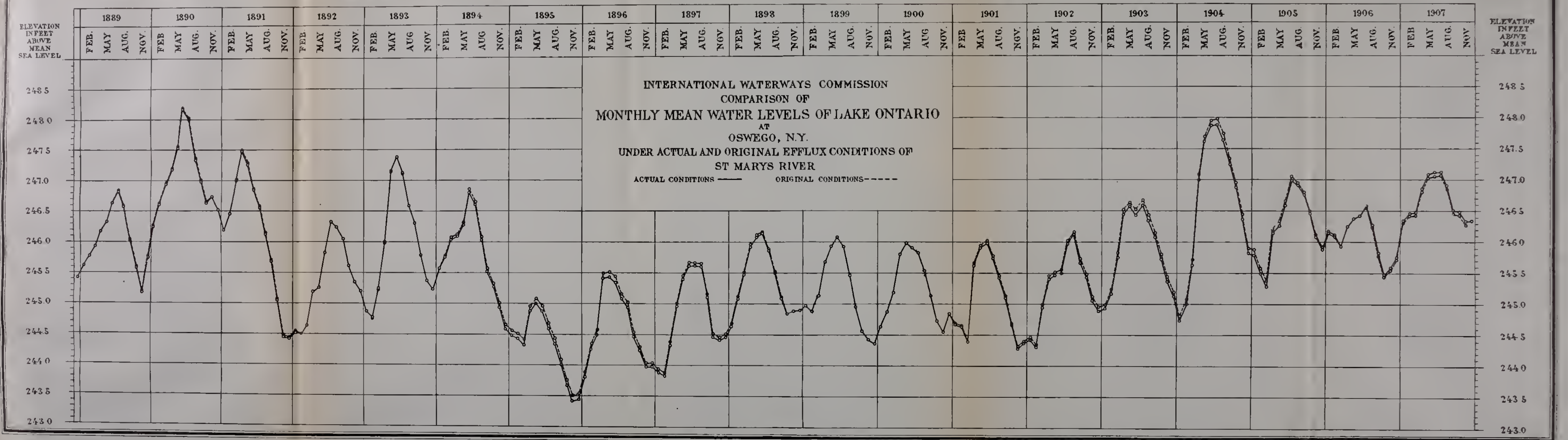
ACTUAL CONDITIONS ——— ORIGINAL CONDITIONS - - - - - -

PLATE 28



INTERNATIONAL WATERWAYS COMMISSION
COMPARISON OF
MONTHLY MEAN WATER LEVELS OF LAKE ERIE
AT
CLEVELAND, OHIO
UNDER ACTUAL AND ORIGINAL EFFLUX CONDITIONS OF
ST MARYS RIVER

PLATE 29



INTERNATIONAL WATERWAYS COMMISSION
COMPARISON OF
MONTHLY MEAN WATER LEVELS OF LAKE ONTARIO
AT
OSWEGO, N.Y.
UNDER ACTUAL AND ORIGINAL EFFLUX CONDITIONS OF
ST MARYS RIVER

ACTUAL CONDITIONS ——— ORIGINAL CONDITIONS - - - - -

MEMORANDUM

FOR THE DEPUTY MINISTER OF PUBLIC WORKS, COVERING THE WORK OF THE INTERNATIONAL WATERWAYS COMMISSION.

BETWEEN OCTOBER 15, 1909 AND DECEMBER, 1, 1910.

The customary meetings of the full Commission were held at monthly intervals and alternately in Toronto and Buffalo.

The subjects taken up during the year were:

1. The proposition by the Long Sault Development Company and the St. Lawrence Power Company to place a dam across the St. Lawrence river, at the foot of Long Sault rapids.
2. The marking on modern charts of the boundary line through the St. Lawrence river and the Great Lakes, between St. Regis and Pigeon river.
3. Regulation of Lake Erie.

LONG SAULT DEVELOPMENT.

This question was again submitted to the Commission on December 24, 1909. Honourable D. S. Alexander, Chairman of the Committee on Rivers and Harbours of the United States House of Representatives, transmitted to the Commission a copy of a Bill introduced by Representative H. Malby and providing for the construction of certain dams, locks, canals and other structures in the St. Lawrence river, at and near Long Sault Island, St. Lawrence County, New York.

This Bill reads as follows:—

'Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Long Sault Development Company, a corporation organized under the laws of the State of New York, its successors and assigns be, and they hereby are, authorized to construct, maintain, and operate for water-power and other purposes a dam or dams across the Saint Lawrence river between points on the United States and Canadian shores of said river near Long Sault island or Barnharts island or Sheek island, and the said islands, or any of them, and between said islands, in and across so much of the said river as lies south of the international boundary line between the United States of America and the Dominion of Canada, either independently or in connection with like works now erected or to be erected in and across so much of said river as lies to the north or Canadian side of said international boundary line, and in connection with such dam or dams, a bridge or bridges and approaches thereto, and a lock or locks, a canal or canals, and other structures appurtenant thereto: *Provided*, That such dam or dams, lock or locks, canal or canals, and other structures appurtenant thereto shall be constructed maintained, and operated in all respects subject to and in accordance with the provisions of the Act entitled "An Act to regulate the construction of dams across navigable waters," approved June twenty-first, nineteen hundred and six: *And provided further*, That such bridge or bridges and approaches thereto shall be constructed, maintained, and operated in all respects subject to and in accordance with the provisions of the Act entitled "An Act to regulate the construction of bridges over navigable waters," approved March twenty-third, nineteen hundred and six, except that the actual construction of the works hereby authorized shall be commenced within one year and completed within fifteen years from the date of the passage of this Act, or from the date of the consent of the proper authorities of the United States of America and the Dominion of Canada to the construction of said works, or of the approval of the plans and specifications and location and accessory works thereof; and this Act shall not be construed as authorizing said company, its successors or assigns, to construct the said dams, canals, locks, and other works until such consent and approval shall be obtained.'

As it will be seen by this Bill and by our Progress Reports for the years 1907, 1908 and 1909, the subject of legislation to authorize power development at that place was not a new one. But, when the promoters of this scheme appeared before the Commission last, it was understood that new plans were being prepared, which were to be submitted at some future date and by which they were to overcome the many objections raised against the proposed undertaking by the interests of navigation. From the time they were last heard by the Commission at its public meeting of Nov. 28, 1908, to the reference by the Committee on Rivers and Harbours of Mr. Malby's Bill on December 24, 1909, the promoters did not communicate with any member of the Commission.

The Canadian Section were of the opinion that they had nothing to do with the matter since it had been referred by the government to the Chief Engineers of the Departments of Marine, Railways and Canals and Public Works.

When the Commission met in Buffalo on January 7, 1910, the objections mentioned in our former reports of the Prime Minister of Canada, to the consideration of the subject had been withdrawn.

The Canadian Section, however, declined at that meeting to join in a report on the ground that many interests were opposed even to the modified scheme of the promoters, and that those interests had to be heard before any recommendation was made. The Commission decided to give all parties full notice of a public hearing which was fixed to February 8, 1910, in Toronto. But, as representatives of the promoters were present it was agreed to hear them immediately. The proceedings of this public hearing is appended marked A.

At the public hearing held in Toronto, on Feb. 8 and 9, 1910, several public bodies and private corporations were heard in opposition to the proposed power development. Others in favour of the scheme, were also given an opportunity of presenting their views. (See appendix B.)

No final action was deemed advisable by the Canadian Section.

At the meeting of the Commmission held in Buffalo, N. Y., on March 11, 1910, a telegram was read from Honourable Frank Cochrane, dated March 10, 1910 stating that the Ontario Government desired a hearing on the application of the Long Sault Development Company. It was decided they would hear Mr. Cochrane in Toronto at the next meeting in April. But Captain Logan being present, the Commission decided they would hear him. (See Appendix C.)

A protest from Geo. A. Stiles, on behalf of the Town Council and Board of Trade of Cornwall was also presented. He summarized his objections to the scheme as follows:

"1. To dam the whole body of water in a navigable river of the dimensions of the St. Lawrence at a point where it is of an international character is an unheard of proposition. The closest approach to it is in the case of the Nile, which however, cannot in size or volume of water, be compared to the St. Lawrence and at a point where similar works are constructed is entirely in Egyptian Territory and when the reason for these works is entirely different from what is urged here.

"2. The scheme proposed by the Long Sault Development Company and the St. Lawrence Company involves the handing over of the greatest natural water power in Eastern Canada to a private corporation.

"3. It further means that the heritage of our people in these resources will be placed within the control of aliens for two reasons: (a) These two development companies are controlled by American wealth. (b) The present plans of the Companies indicate the physical location of the power development in United States Territory.

"4. The scheme is altogether premature; no demand for any such horse power as would be developed here, the amount of which is practically untold, exists in Eastern Canada.

"5. It would not be possible for boats to pass uninterruptedly down the river as now, but locking would be necessary in every instance.

"6. Such a dam as is proposed would undoubtedly raise the level of the water in the river at points west of it very seriously, and would almost undoubtedly cause yearly ice jams and consequent flooding.

"7. One of the finest of our natural beauty spots, which is more or less invested with historic associations would be entirely blotted out.

"8. International complications would almost certainly arise because our interest in the power in the proposed scheme could only be secured by treaty and treaties, as every reader of History knows, are notoriously violated.

"9. So far as I have become familiar with the plans of the promoters, not one single horse-power is to be developed in Canada.

"10. The United States would be in a position to put an export tax on power exported to Canada.

"11. There is plenty of opportunity for splendid power development on this side of the river without resorting to any such radical work as is proposed.

"12. The water supply for this town and points east, which is now the finest in the world. would undoubtedly seriously deteriorate if the rapids were obliterated and this risk would be further increased, if any considerable population should gather about the proposed work.

"13. The scheme amounts to the placing of an American gate across the St. Lawrence.

"14. Tourist traffic would be seriously diminished.

"15. It is undoubtedly a fact that the coal supplies on this continent are being seriously reduced and it can only be a question of a very short time before the sources of electrical power will be of the utmost value. Under these circumstances it would be a mistake of the highest importance to hand over these rapids to private companies promoted by foreign capital."

The members of the Canadian Section stated they did not desire at this time to join with the American Section in a report to the Chairman of the Rivers and Harbours Committee on Bill H. R. 14531, and it was decided that so far as the full Commission was concerned, action on the application of the Long Sault Rapids Development Company would be deferred.

The American Section, however, stated that they felt compelled to make a report immediately on the ground that the session of Congress was so far advanced that no further delay was permissible if the report was to be of any service to the Committee on Rivers and Harbours. They decided therefore to express their own views and did so in a report dated March 11, 1910. This report is annexed to the Sixth Progress Report of the Amercian Section dated November 1, 1910.

The American members of the Commission, with a view to fully recognize the necessity of co-operation between the Government of Canada and the Government of the United States in the approval of plans, the supervision of the construction of the works, and the establishment and enforcement of regulations for operating them, suggested in their report several amendments to the Bill. For instance the following section—

'Section—.This Act shall not become operative until the government of the Dominion of Canada shall signify to the Secretary of State of the United States its consent to the construction of such dam and other structures: *Provided*, That if said consent be not given within two years from the date of this Act, then this Act shall be null and void.'

The conditions provided in the Bill for the protection of navigation and other public interests are contained in a reference to two United States laws which apply to streams which are exclusively American. To make them applicable to the St. Lawrence the American Commission suggested that the following additional provisos be introduced:

'*And provided further*, That all plans, drawings, and maps, and all deviations therefrom and modifications thereof, either before or after completion of the structures, and all conditions and stipulations which may be imposed in connection with the erection, use, and operation of the dams and works shall first be submitted to and approved by the International Waterways Commission: *And provided further*, That the construction, maintenance, regulation, and operation of such structures shall be in accordance with any agreement which may be made in reference thereto between Great Britain, acting on behalf of the Dominion of Canada, and the Secretary of State of the United States, acting on behalf of the United States, with the assent of the Secretary of War.'

Additional sections as follows were also suggested—

'Sec.—.The dam or dams, and lock or locks, and other works shall be constructed under the supervision of an engineer to be designated by the Secretary of War; when completed the title to the lock on the south side of the boundary shall be conveyed to the United States, together with perpetual right of access thereto by the officers and employees of the United States over any and all parts of said dam and over any and all approaches thereto and over any and all bridges. The Long Sault Development Company shall maintain said locks, dams, bridges, and approaches and make all repairs thereon in such manner and at such time as may be directed by the Secretary of War, and in case of its failure to do so the Government of the United States may maintain said works and make repairs at the expense of the said company, which company shall reimburse the United States therefor. Of the power generated by the works herein authorized, an amount which in the opinion of the Secretary of War shall be sufficient to operate any lock or locks which may be constructed shall be furnished free of charge to the government of the United States.

'Sec.—.When completed the title to the dam or dams on the south side of the boundary shall be conveyed by the Long Sault Development Company to the United States, subject to perpetual right of user by the Long Sault Development Company and its successors, without payment for such use, except in case of forfeiture: *Provided*, That in case the said company shall at any time violate any of the provisions of this Act, or fail to comply with the directions of the Secretary of War or the chief of Engineers, or with any conditions or regulations which may be imposed by the International Waterways Commission, with the approval of the Secretary of War, or with any conditions or regulations which may be made pursuant to any agreement between the United States and Great Britain, on behalf of the Dominion of Canada, the President of the United States may declare the said right of user forfeited, and so much of said dam or dams and their approaches, and of said bridges, as lie south of the boundary, shall thereupon become the property of the United States, free and clear of said right of user.

'Sec.—.The United States shall be entitled to use the waters impounded by said dam and works for the purpose of operating the lock or locks which may be constructed south of the boundary line, in such manner and at such times as the Secretary of War may require, and the United States shall at all times have the right to control the use of the dam or dams and the levels of the pool or pools formed thereby, to such extent as may be deemed necessary by the Secretary of War to provide proper facilities for navigation, and the withdrawal of water from such pool or pools for the purpose of generating power shall be subject to such regulations as may be made by the Secretary of War, or by the International Waterways Commission, with his approval, and shall at no time be such as to impede or interfere with the safe and convenient navigation of the said river by means of steamboats or other vessels or by rafts or barges.

'Sec.—.The Long Sault Development Company, its successors and assigns, shall construct such suitable fishways at said dam or dams as may be required from time to time by the Secretary of Commerce and Labour.'

The time allowed in the Bill for completing the works—fifteen years—seemed to the American Commissioners too great. They recommended that it be reduced to five years, and that a new section be introduced as follows:—

'Sec.—.The actual construction of the works herein authorized shall be begun within one year and completed within five years from the date when this Act becomes operative.'

The principle that after navigation is fully provided for the surplus water available for power purposes shall be equally divided between the two countries was not mentioned in the Bill. But the American Commissioners thought it should find a place there, and they recommended that an additional section be introduced ,worded as follows:

'Sec.—.One half the power generated by the works herein authorized shall be delivered in Canada when needed there, and the other half shall be delivered in the United States when needed there, and the price charged shall be the same on either side of the boundary: *Provided*, That in case a market can not be found in one country for the full share thus assigned to that country, the surplus may be temporarily diverted to the other country, but shall be returned to the country to which it belongs when needed there.'

Finally they added a section to the Bill reserving the right to alter, amend, or repeal it.

A subsequent and last public hearing on the subject was held in Toronto, on April 15, 1910. The Ontario Government represented by G. Lynch Staunton, K. C. and other parties were heard in opposition and in support of the proposed works. (See Appendix D.)

The Commission took no action on the matter.

The Canadian Government did not require the Commission to make a report. Mr. Malby's Bill before the United States House of Representatives failed to become a law and the American members of the Commission seemed to take no interest in the matter after their report to the Committee on Rivers and Harbours dated March 11, 1910.

At a meeting of the Commission held in Buffalo on August 26, 1910, Mr. John H. Finney representing the Long Sault Development Company, extended to the Commission an invitation to visit the site of the proposed works in the St. Lawrence river, at the Long Sault rapids, either that day or on some future date to be decided on. The Commission then adopted the following resolution:

'Resolved: That owing to the fact that the plans of the Long Sault Development Company will have to be dealt with by the new International Joint Commission to be appointed under the recent treaty between the United States and Great Britain, the International Waterways Commission feels it is not advisable for them to accept the kind invitation of the Long Sault Development Company, extended to the Commission by Mr. Finney to visit the site of the proposed works of the Long Sault Development Company near Long Sault island, in the St. Lawrence river.'

International Boundary Line Through the Great Lakes.

In accordance with the terms of the treaty signed on 11th April, 1908, the Commission has been engaged during the past year in the continuation of the work of marking the boundary line through the Great Lakes, and has made very substantial progress along the lines detailed in my memorandum covering the work of the Commission between March 1st, 1908, and October 15, 1909.

New charts of the St. Lawrence River, the Great Lakes and communicating waterways are being prepared.

There will be 30 in all, including an index chart; the rivers on a scale of $\frac{1}{20,000}$ and the lakes on a scale of $\frac{1}{300,000}$.

Three charts will be made on a scale of $\frac{1}{60,000}$ for:

Eastern end of Lake Ontario;
Western end of Lake Erie;
Lake St. Clair.

One chart, covering Niagara Falls and vicinity will be: $\frac{1}{10,000}$.

About 65 per cent of the drafting and 44 per cent of the engraving of these charts has been completed.

By Article IV of the treaty, 'the existing International Waterways Commission is authorized and empowered to ascertain and re-establish accurately the location of that portion of the international boundary line extending through the St. Lawrence river and the Great Lakes, between St. Regis and Pigeon river, Lake Superior.' It is agreed that 'wherever the boundary line is shown on the old boundary charts by a curved line along the water, the Commissioners are authorized, in their discretion, to adopt, in place of such curved line, a series of connecting straight lines defined by distances and courses and following generally the course of such curved line, but conforming strictly to the description of the boundary in the existing treaty provisions, and the geographical co-ordinates of the turning points of such line shall be stated by said Commissioners so as to conform to the system of latitudes and longitudes of the charts to be prepared; and said Commissioners shall, so far as practicable, mark the course of the entire boundary line located and defined by buoys and monuments in the waterways and by permanent range marks established on the adjacent shores or islands, and by such other boundary marks and at such points as in the judgment of the Commissioners it is desirable that the boundary should be so marked; and the line of the boundary defined and located as aforesaid shall be laid down by said Commissioners on accurate modern charts prepared or adopted by them for that purpose; and the Commissioners shall also prepare a joint report describing in detail the course of said line and the range marks and buoys marking it, and the character and location of each of the boundary marks.'

In the preparation of these charts it was found that there were many inaccuracies in the old charts, and some survey work has become necessary, particularly in the upper Niagara river, the St. Marys river, and in the lower Detroit. These have been completed; but there still remains to make a detailed survey of Pigeon bay, Lake Superior.

As the whole boundary line is through the water, it has not been considered advisable to place a permanent beacon at each change of direction; and it was considered both inadvisable and impracticable to place and maintain buoys. It, therefore, became necessary for the Commission to adopt some other method, and it was finally decided to place a monument on the shore, abreast of or at some convenient point in the vicinity of each turning point.

In the preparation of the report, called for by the treaty, the geodetic positions of all these monuments and the turning points will be given, and the azimuth and distances of the turning points from the fixed monuments, stated. In this way any person desirous of locating the boundary either on a map or in the field, can do so.

A great deal of consideration was given to the question of the material of which the monuments should be constructed, and it was finally decided that nothing would answer the purpose better than concrete in the form of the frustum of a cone, with hemispherical top. The part below ground is 5 feet deep and 2½ feet in diameter. The visible portion is 2½ feet high, 2 feet in diameter at the base, 1½ feet in diameter at the top of the frustum, and the hemisphere has a radius of 9 inches. A copper pin is inserted in the centre of the top of each monument to mark the point with precision. Each monument has also a separate number cast in its side when being moulded. For this purpose, detachable steel moulds were made from designs prepared by Mr. W. Edward Wilson, secretary of the American section of the Commission, and the work of placing the monuments was begun in July at St. Regis and extended as far as Morrisburg, Ont. For this stretch of river (about 32 miles long) 35 monuments were placed by one small party.

For the coming season, it is proposed to push the work of placing monuments to completion, and three parties will be placed in the field, one on the St. Lawrence river, one on the Niagara, Detroit and St. Clair rivers, and one on the St. Marys river.

Pending the completion of the Commissioners' charts, no definite location of the boundary line has been made along any part of the system. This will be left until the completion of the charts and field work.

Most of the data for the construction of these charts is obtained from the United States Lake Survey, as they have performed most of the hydrographic work on the Great Lakes, viz: all their own shores and quite a large portion of the Canadian shores. The balance of the Canadian shores has been done by the Canadian Hydrographic Survey, and their records have been placed at the disposal of the Commission.

Regulation of the Lake Erie.

At a meeting of the Commission held in Toronto on 14th and 15th June, 1905, one of the subjects for discussion and report was 'as to the advisability of building controlling works at the outlet of Lake Erie, including the effect on the lakes and rivers, upon their shores and upon the River St. Lawrence.' A committee of the Commission consisting of Messrs. Coste and Haskell was appointed to undertake the gathering of data and the investigation into this important matter. This committee, after a very large amount of labour, presented its report on December 15, 1909, and the full Commission took the matter into consideration and issued its report on the January 8, 1910.

In submitting the question to the Conmission, Congress had before it a report of the board of engineers appointed to investigate a scheme for deep waterways between the Great Lakes and Atlantic tide water, in which it was recommended that the level of Lake Erie should be 'regulated 'by means of a submerged weir in connection with a set of sluice gates placed at its outlet near the head of Niagara river, and it was into the regulation here described that the Commission inquired. Roughly speaking, it was found that the low water stage of Lake of Erie could be raised about one foot, thus raising Lake St. Clair 0·61 of a foot, and Lake Michigan-Huron 0·27 of a foot, without raising the high water stage. But to do this would mean the lowering of the low water stage of

Lake Ontario 4½ inches and decrease the depth on the St. Lawrence canal sills by 7·66 inches.

The City of Buffalo, its southerly suburbs and all the low land around the lake, such as Cong Point, Point Pelee and Pelee island, Sandusky bay would suffer by increased damage from floods and from a postponement of the date of opening navigation in the spring.

In weighing the advantages and disadvantages, the Commission considered that the advantages were not of such overwhelming character as to justify both governments in entering upon the work of regulating Lake Erie.

The report of the Commission on this important matter has been published. (See page 781).

There remained to be considered whether compensating works of some kind may be constructed, which will benefit the navigation of the waters above without injury to those below, and with only minor damages if any, to the adjoining land.

The Commission is now engaged in the study of this most important problem. And as soon as the necessary surveys are completed, a supplementary report will be submitted.

The whole respecfully submitted,

THOMAS COTE,
Secretary, Canadian Section.

Ottawa, Ont.,
November 15, 1910.

APPENDIX A.

Proceedings of public hearing at Buffalo, N. Y., January 7, 1910, in reference to Bill H. R., 14531, being a Bill for the construction of locks, dams, canals, and other appurtenant structures in the St. Lawrence River at or near the Long Sault Island, St. Lawrence County, N. Y.

Buffalo, N.Y., January 7, 1910.

General ernst: The secretary will take the names of the gentlemen who wish to address us.

Gentlemen: You are all familiar with the object of this hearing, which is, to hear the promoters and the opposers of the power development at the Long Sault. Mr. Davis, representing the American company, and Mr. McCarthy, representing the Canadian company, are here on behalf of the promoters, and, if you do not object. I will call upon them first. In the meantime, the Secretary will go about and get the manes of the other gentlemen who wish to speak.

Mr. Davis, it is suggested that I state that our time is somewhat limited. One of our members would like to get away about noon and we would like to have you make your statement as concise as possible. Of course we do not want to cut you off.

COMMISSIONER GIBBONS: I would suggest, before Mr. Davis speaks, this: The Commission have had this matter before them several times. The principle adopted by the Commission, I merely repeat,—that these developments should be permitted where they can be permitted consistent with the interests of navigation. There has been very strong opposition to this scheme on the part of some people in Canada because admittedly it did interfere with the navigation of the river by the Richelieu and Ontario boats. It has been said, on the other side, that the general interests of navigation would be benefited; that, although the boats would not run these rapids, and of course, they would not if the rapids were dammed, the interests of navigation, as a whole, would be benefited rather than injured by these improvements. I may say to you that that is the one point about which some of the Commission, at any rate, want more information on. There are no opponents represented here. They were not notified to be here. It was not understood by them that this matter was to come up at this hearing. It is for you to say whether you would consider it politic or not to now go into the matter fully, or, rather to go into it at a meeting which I think should be called in Canada, open to the press, when this whole matter should be threshed out, and when the opposers to the scheme would state definitely what their opposition is based upon. There have been resolutions, as you know, of the Marine Association, of the Boards of Trade, against the proposal, and we have a right, I think, to ask them why they have passed these resolutions. You should be present. They should give their reasons; you should answer; and this Commission should decide this important question to the best of their judgment after hearing these matters threshed out by all those concerned. Nothing would be more impolitic than that there should be any decision that would leave it open to any body to say that their case had not been stated. I do not think it is either in the interests of your Company or otherwise that there should be any snap judgment given with regard to a matter which, to a great many people, is considered very important. You are asking to dam a river that has been for all time open. It may be desirable, bearing in mind the general principles that this Commission has adopted, that that should be done, but it should be only done when the reasons are patent to the public and justify it. It would block this Company rather than facilitate its operations if the Commission, without proper evidence and proper consideration, would say that you should place this dam in the St. Lawrence river. I think the good sense of the gentlemen who are promoting this scheme will show them that delay would be politic in their own interests,—that this is not a matter that can be forced against public opinion. The government of Canada have to give their consent. I still do think that we ought to have one more hearing at which everybody should have a chance to have their say and then the Commission should, after considering the matter, give their report and give their reasons for the report; and whatever the report is they should be ready to justify it as having been given upon proper consideration of the whole matter. The Americans do not navigate the St. Lawrence; it is Canadian; Canadian boats only are there in operation, and it is Canadian interests in a sense only that are affected. This meeting to deal with it should be where these people who object have a chance to say what grounds they have for their objections. I am sorry to say that herefore there were constant resolutions without giving the reason upon which those resolutions were based. Now, I think we have a right to say to the Marine Association 'Why do you oppose? It is said that this will assist navigation and not injure it; what do you say to that?' And, in the presence of both sides, let the Commission hear the whole subject threshed out.

I only say these things, gentlemen, with a view to shortening matters if possible, but I think I express the general view of the Commission as to what is in our minds and what are the issues.

GENERAL ERNST: I understand there is opposition here, but we will let the development company speak first, Mr. Davis.

MR. DAVIS: Mr. Chairman and gentlemen: I appear in behalf of the Long Sault Development Company, a New York corporation chartered by a special Act of the New York State Legislature.

There has been introduced into Congress of the United States a Bill authorizing the Long Sault Development Company to construct these works in the St. Lawrence river in so far as these works lie in American territory, and this bill having been referred to the Rivers and Harbours Committee of Congress is now officially, as we understand it, before the International Waterways Commission, or at least before the American Section of the International Waterways Commission, with the idea that the Commission will report to the Rivers and Harbours Committee. In so far, therefore, as we are pressing for an early hearing, we are only actuated by a desire not to interfere with the course of the legislation in Washington. We have no desire at all to embarrass either the Canadian Section of the Commission or our confreres in the enter prise in Canada. We have our engineers here this morning and we are quite ready to explain the details of the project as fully as you may desire to listen to them, and to answer any question which you may desire to ask.

MR. MCCARTHY: Mr. Chairman, and gentlemen: I apprehend that Mr. Gibbons, the Chairman of the Canadian Section, misconceives the position which the Canadian Company is in in coming here to-day. We have never sought to rush the matter. We have never sought to unduly press the matter.

On or about the 28th of December, I communicated by telephone with Mr. Gibbons and told him that I understood that the American Section desired that this matter should be heard in order that they might make a report to Congress upon the Bill of the Long Sault Development Company, which had been introduced in Congress, and that for that purpose they desired the Long Sault Development Company to appear here at the meeting which was to be held on the 7th of January. Mr. Gibbons suggested to me then that that was too soon from the Canadian standpoint; that there ought to be more notice given; and that in any event, or moreover, that such meeting for the purpose of hearing the Canadian interests which were opposed should take place in Canada. I immediately told Mr. Gibbons that we had no objection to that, but that from the point of view of American legislation it was necessary that there should be speed, and for that reason we must comply with the requests of the American Section and appear jointly with our confreres at this meeting. I understand, with all respects, that Mr. Gibbons has said that the Dominion Marine Association did have notice that our plans had been filed and that we intended to appear here to-day; and, further. I have this to say, that the President of the Dominion Marine Association was in Toronto on his way to Buffalo, I understand, the day before yesterday.

COMMISSIONER GIBBONS: Mr. Stewart told him that it would not come up.

MR. MCCARTHY: Mr. Stewart, however, had notified them that it would come and that plans had been deposited and that the American Section were desirous of hearing the matter. Now, the position, as I conceive it to be to-day, is not that we are pressing the Canadian Section at all. We do not desire to do that, though we are perfectly ready to go on. If the American Section can, according to the rules and procedure adopted by this joint high Commission, make their report to Congress upon this matter without the Canadian Section joining in it, then there is absolutely no objection from our standpoint of having the matter stand to a later day for a hearing in Canada to hear all parties that are opposed from the Canadian standpoint. If that be possible,—and you gentlemen of the Commission know whether it is or not—a great deal of discussion will probably be obviated. Is that possible?

General Ernst: That is possible, yes.

Commissioner Clinton: No, not exactly..........

Mr. McCarthy: Then may I go one step further, if I am not intruding?

Commissioner Clinton: I do not think it possible, in one sense, and I do not think it is politic. The Commission have always dealt with these matters as a whole. They are one Commission. There are three Canadian members and three Americans, but it is one Commission. We have made several reports to our governments upon different matters, but the Commission should act as a whole upon every matter that comes before them. There would be nothing so unfortunate as that the Commission should get into two classes, one Canadian and one American. It is really one Commission acting for both countries.

General Ernst: I said it was 'possible' to do so.

Mr. McCarthy: Mr. Gibbons suggests it is not politic, although it is possible. I then have to say that if that situation cannot take place, look at the position in which you are placing the Long Sault Company. The American Section, if it is ready to report, is being held back by the Canadian interests because they say they have not had time to consider the scheme and that a sufficient notice has not been given. Now, practically ten days notice has been given, and, further than that, a good deal more notice has been given, because the president of the St. Lawrence Power Company, discussing with the only opponents that have arisen in Canada, namely, the Marine Association, represented by the President of the Richelieu and Ontario Navigation Company, about the 15th of December, while that Association was in session in Toronto, was told that at the next meeting of this Commission we were going to use our best endeavours to have this matter disposed of. Therefore, for a period of some twenty three or twenty four days, they have known. They were formally notified by the Secretary, or Acting Secretary of the Canadian Section, about the 29th of December. Now, I understand that unless the Commission does report to Congress and the Bill which is introduced makes considerable progress before the first of February, that that bill is very likely to be unduly delayed and hampered in its progress through Congress. If that is so, the Long Sault Development Company on the American side is put in a very difficult position. It is for you, gentlemen, to say whether it is put in a fair or an unfair position.

Now, I am a Canadian, and I take no second place to any Canadian in fighting for Canadian interests, but I am not so far prejudiced that I could say to my fellow countrymen that 'you have had three meetings in reference to this matter in Canada ; you have been allowed to say all you can say in the City of Toronto twice, and the city of Montreal, once; that when it came to a fourth discussion of the matter that it would be unfair to have that discussion take place in the United States.' If the Dominion Marine Association thought that this notice was too short, they should be here to say so. The Dominion Marine Association, or, joining them all, all the opponents of the scheme, were offered, as I thought most magnanimously, by the Chairman of the Canadian Section on the approval of the Prime Minister of Canada, three years ago and two years ago it was repeated, the services of an engineer or engineers to be named by them, free of cost, to investigate this proposition, to have access to our plans, which we promised them we would give them, to explain fully to them this scheme. They have never to this moment availed themselves of that offer. They practically, as Mr. Gibbons will remember, Mr. King speaking on their behalf, refused to put themselves in the hands of an engineer. Their arguments have been all of the same character; 'Hands off the St. Lawrence. You can't touch it, because it is a channel that should not be touched, for the Richelieu and Ontario Company manage it or use it and there is no right to have interference.' The Commission have enunciated a principle to those gentlemen in as plain language as possible. No language could be more plain than that used by Mr. Gibbons: 'If navigation is interfered with, no works will be permitted; if navigation is not interfered with, works may be permitted.'

You have had three hearings. What tittle of evidence have they submitted to this Commission that navigation will be interfered with? On the contrary, aren't you all satisfied from the statements that have been made, from the plans that have been filed, from the descriptions and the plans filed, that navigation will be vastly improved? The whole point, as Mr. Gibbons puts it this norning, is whether or not navigation will be improved or otherwise. Now, what are we to do? We want to be reasonable; we want to meet the views of you, Mr. Chairman, of your Section; we want to meet the views of the Canadian Section, but we do not want this year to go past without our getting the legislation at Washington that is necessary to the advancement of this scheme, nor do we want the Parliament of Canada to rise without our getting the approval of this scheme there. Both of these legislative bodies will rise early in the spring, according to the looks now. What, again, I repeat are we to do under these circumstances, with every desire to be reasonable, with every desire to meet the wishes of everybody? We have not gone by any back door methods; we have invited these men to have the most thorough investigation of our plans. They have been writing newspaper articles in conjunction with the testimony of the Montreal Light, Heat & Power Companies, and other kindred newspaper articles, attacking us for three years. They know our scheme—at least they profess to know it—and they cannot say with any fairness that they would be taken unawares; that they would be taken at too short notice; that they desired to appear here to-day. They have not come. Why haven't they come? There isn't any doubt but that they were notified.

COMMISSIONER GIBBONS: This Commission did not arrange to take this matter up at all today. I did not understand it was to be taken up either yesterday or to-day. The Commission had not arranged it. They may have given the notice, but Mr. Stewart, understanding that it was not to come up, informed the President of the Marine Association that it would not be taken up.

(At this point, an informal discussion took place as to the advisability of a hearing at Toronto in the near future, at which time and place the applicants, and others in favour of, and those opposed to the proposed development, should be heard.)

MR. MCCARTHY: Shall we withdraw and enable the Commission to discuss the matter?

GENERAL ERNST: Well, gentlemen, if there is nobody here who cares to address us, it will be well to close the public hearing. If there should be another meeting, you will be notified, but it is not usual for us to ask people to come and see us; it is generally granting permission or granting our consent to hear them.

MR. MCCARTHY: Perhaps, if you would permit me to state this without occupying more time, that there is here to-day the representative in the person of Mr. Robert Pringle, K. C., appointed by the Cornwall Board of Trade and the Cornwall town council and others, to address you on their behalf in favour of this scheme, wanting the application approved in order that they may have power delivered to their door; likewise, does Mr. Powell, of Brockville, representing the town council of Brockville; Mr. McLaren, the President of the Board of Trade of Brockville, who would be prepared to address you if it was thought wise; likewise; Mr. Dowsley, of Prescott, representing the Board of Trade of that town. And I have also, which properly should be mentioned, the memorials from the municipality of the town of Alexandria, the town council of Cornwall, the Cornwall Board of Trade, signed by forty members, the municipal council of Prescott, and others. I will leave them if you wish.

GENERAL ERNST: We will then consider the hearing closed.

APPENDIX B.

PROCEEDINGS at Public Hearing held in Toronto Feb. 8 and 9, 1910, on the project of the St. Lawrence Power Company and the Long Sault Development Co.

TORONTO, Tuesday, Feby. 8, 1910.

The Commission met in the Queen's Hotel at 12 o'clock.

Present—Canadian Section: George C. Gibbons, Esq. K.C., Chairman; W. J. Stewart, Esq. C. E.

American Section: Brig.-Gen. Ernst., chairman; George Clinton, Esq.; Prof. Haskell; W. Edward Wilson, Esq., A. S. C. E., Secretary.

The following deputations were present:—

Long Sault Development Company: Leighton McCarthy, K. C.; J. W. Rickey, C. E.; Henry Holgate, C. E..

The St. Lawrence Power Company: Leighton McCarthy, Esq., K. C.; Geo. C. Foster, K. C.

Richelieu & Ontario Navigation Company: R. C. Smith, K. C.; C. J. Smith, manager.

Ontario Government: Hon. Adam Beck, Minister of Power; Irwin Hilliard, Counsel.

The Commission of Conservation: Jas. White, Secretary.

Dominion Marine Association: Francis King, Secretary.; Frank Plummer, Lake Freight Ass'n.

Montreal: Eugene Lafleur, K. C., representing Montreal Board of Trade.; John Kennedy, C. E., Engineer Harbour Commission; T. J. Coonan; Arthur V. Davis; George G. Foster;

Toronto Board of Trade: W. J. Gage, President; F. G. Morley, Secretary; Barlow Cumberland.

Prescott: F. S. Evanson, Mayor; J. K. Dowsley; I. P. Wiser.

Massena: Capt. W. W. Cline.

Shipping Federation: F. E. Meredith, Esq.

Brockville: A. M. Patterson, Mayor; W. C. Maclaren, President, Board of Trade; H. A. Stewart, K. C.; Jas. A. Hutcheson, K. C. Town Solicitor; W. S. Buell, Ex.-Mayor; W. H. Davis; J. Webster; J. A. Mackenzie; Dr. S. Cowan; W. H. Osborne; W. E. Brough; D. W. Downey; C. S. Consitt; A. T. Wilgress; G. Barclay; R. Bowie; C. K. Fraser; W. H. Kyle; G. Ross; W. B. Thomson; C. T. Wilkinson; W. Shearer, Secretary, Board of Trade; Senator Derbyshire.

Cornwall: Robert A. Pringle, K. C., representing Town of Cornwall and Board of Trade; P. E. Campbell, President and General Manager Montreal & Cornwall Navigation Co.

Morrisburg: Geo. H. Watson, K. C., representing Morrisburg and adjoining municipalities.

Chairman Gibbons: Having adjourned the meeting until 2 o'clock on account of the absence of Brig.-Gen. Ernst and Prof. Haskell, owing to a delay in railway connection, resumed the chair at 2 o'clock.

Chairman Gibbons: I am exceedingly sorry that owing to the lateness of the trains from New York and Washington two of the American Commissioners,—General Ernst, chairman of the American Section, and Professor Haskell—may not be able to reach Toronto till 4.30. After consultation with the other member of the American Section, Mr. Clinton, it has been thought better to proceed, on account of the large number of people who have come here. What is said by the gentlemen will be taken down in full in shorthand, and of course the Commissioners who are not here will have the benefit of these remarks. The importance of the question which is to come before the Commission is evidenced by the size and importance of the delegations in attendance. I am not going to make a speech, I am merely going to suggest to you the main issues that will have to govern any decision that this Commission may reach in regard to this matter— this being an International Board dealing with these international streams, and being an advisory Board merely. The Commission has agreed upon certain principles governing the use of these boundary waters. The first was that the interests of navigation were paramount, but that wherever, without material injury to the interests of navigation, developments for power could be permitted by the use of these waters, that permission should be granted, but subject to the condition that each country was to be ensured one-half the advantage from such development. Now, a strong objection has been made—there may be a great many others—that the present proposal involves the damming, by a series of dams, of the St. Lawrence river—a navigable stream of which both countries have by treaty a common right of use. And there is a further question, whether the scheme as suggested is capable of being worked out in such a way as to ensure to the people of both countries an equal division of the power generated. I should be very glad if you would arrange the order of your speakers and give us the names of these. Of course we will first hear from those who will explain the proposal of these two companies, one Canadian and one American. They propose jointly to deal with this question. If you cannot give us a list of the names we would call upon them. If Mr. McCarthy is here I will call upon him.

Leighton McCarthy, K. C.: Mr. Chairman and gentlemen of the International Waterways Commission: As I understand this matter, the Commission has met for the purpose of again discussing this somewhat important international matter. It is by no means a new matter to the members of your commission. In October, 1907, this scheme or proposition was laid before this Commission in this room. A month or two later, in view of certain criticism or in view of the importance of it from the standpoint of the City of Montreal, you, Sir, convened a meeting there, and the matter was very fully discussed by the representatives of the respective power companies, and likewise by those who were interested in seeing that all the details of the scheme were laid there, and in protecting whatever rights or interests they might have upon the River St. Lawrence. Again in November, 1908, your Commission was in session in Toronto, and again was this matter discussed. On the 7th January of this year the matter was discussed again before this Commission in Buffalo, and then it was suggested that a meeting should be held in the City of Toronto for the purpose of further discussing it. The original proposition made by the companies desiring to develop power at the Long Sault rapids in the St. Lawrence river was presented to the Government of Canada in December, 1907. The plans and proposition were discussed in a conference between the engineers of the power companies and the Government engineers. Certain modifications or changes in that scheme or proposition were suggested, resulting in an amended proposition or petition being submitted to the Government of Canada in January, 1909. That, Sir, is the scheme which you are now considering. As I said in opening, this is an international matter. It is not a matter involving only the interests of one country; it involves the interests of the great republic to the south of us as well as the interests of Canada. Both companies therefore ask a broad consideration of the scheme which they are submitting for the development of this large proposition. It will better Canada as it will better the United States. We ask for a united effort on the part of Canadians and Americans for the betterment of the citizens of both countries. It is recognized by each country that the consent each gives must be subject to the consent of the other. Never has either company asked of its Government anything else than that the approval of this scheme should be subject to the approval of the other country. Therefore we come before you asking, in the interests of progress and development, that a broad national view of this progressive proposition be given. The water which now passes down the Long Sault rapids has for all those years practically run to waste. It is said that a large amount of power can be developed there. The citizens of Canada and the citizens of the United States in that immediate locality are far removed from the coal-mines, which are the steam producers of both countries where you have not got water-power. This water-power, therefore, is to this locality the same thing as a coal-mine is to the localities in Nova Scotia or the west, or to the same thing as the coal-mines of Pennsylvania are to the people in that locality. Now, Sir, you will bear me out that we have from the beginning agreed in endorsing and accepting the statement which you have so well made with reference to the interests involved in this proposed scheme, or affected thereby; and at the present time, as I understand it, if trouble there be in the minds of any of the members of the Commission, it is solely and only on the subject of navigation. Speaking in Toronto in 1908, Sir, you said:—'No permission would be given to anybody that does not give complete and absolute control to some representatives of each Government, whatever form it takes. At present this Commission may be given greater power to deal with these questions relating to boundary waters; but at all times they will be subject to the control of some body so that the interests of navigation will be protected to the utmost. There is no danger at all from anything of that kind, not the slightest. The one great big point here, and the only one point, is whether these proposed improvements—which ought to be granted if they are not an injury to navigation— will be an injury or a benefit upon the whole—and you have to look upon them as a whole. Now, that is all there is to it. You need not be afraid but that the matter will be very seriously considered by all the members of the Commission, who will seek to get at the principle and do what is right under the principle established, and which are the only proper principles to govern them in dealing with what are international waters. We do not want and must not allow any little jealousies between the two countries to arise. Nobody has any property in this water; it is not American water, it is not Canadian water; it is common use.' 'You likewise spoke, Sir, in just as distinct terms in the City of Montreal in November, 1907. You told the parties interested in navigation:—'The interests of navigation are to be in all cases paramount and subject only to the right of use of the water for domestic purposes. That is to say, that where water is taken at Sault Ste. Marie, one-half of the surplus water that can be taken without interfering with navigation should be reserved for the use of the Canadian people. That principle has been adopted by the general Commission. Now, this application comes before the International Waterways Commission, being an international matter, and has to be dealt with by both Governments. Of course, it is the desire of the Commission and in the public interest, that where power can be developed without injury to paramount rights of navigation it should be permitted; but if there be interference with these rights, of course it cannot be allowed.' 'Again, later, in speaking in reply to a gentleman, you put it possibly more succinctly, and very much to the point, when you said:—'You can rely upon that. 'I said at the opening that the principle agreed upon by both sections of the Commission, United States, and the other, is that the interests of navigation are paramount. The only idea was that we should allow public improvements consistent with that, but not otherwise. It is to get at some means of finding what the truth is that we are holding this meeting.' Now, as I say, we concede that the interests of navigation are paramount. What is the situation, then, as to navigation interests? And what are the navigation interests involved? We assert, our engineers advise us, and we have not heard of any engineer that says to the contrary, that not only will navigation not be prejudicially affected at this particular point, but that it will be very vastly and greatly improved. We have yet to hear from any engineer expert that the navigation interests at this particular point will not be improved if our proposed scheme is allowed to be carried out. It has been suggested, it has been currently said, 'Oh, but you must not dam the St. Lawrence.' Sir, that is correct, technically correct, but we are not damming the St. Lawrence in the sense that that gentleman desires the public to understand. The dam or dams that will be put in there are at an impassible point—at the Long Sault rapids—which is not used by the great majority, yes, almost all of the vessels which ply St. Lawrence route—with but one or two exceptions which I will deal with later. No vessel going west uses the Long Sault rapids or the St. Lawrence river at that point. To day, be you a Canadian or be you an American going west, you must use the Cornwall canal; without that you cannot get west of the Long Sault rapids. You have to make seven lockages to get through the Cornwall canal. By this scheme we do not propose to affect in any manner whatsoever the Cornwall canal, which is to be left intact and its integrity is to be preserved. So that, as all vessels going west must use the Cornwall canal, therefore going west you will not be interfered with to the slightest extent. Now, what are the navigation interests on the St. Lawrence river that are going to be affected by this work, and what do they think of this proposition? It is a very simple proposition, if the scheme is practicable and feasible at all—and we have heard no engineer say that it was not practicable and feasible, not one. We offer to the navigation interests, going east and going west two channels where you have one. We offer to build for the navigation interests a new lock with but one lift. We tell you, and we assert to you, and we say that we will make good on that—that there will be ample facilities and lots of water to handle the shipping interests that now ply upon the St. Lawrence river. Is there any man within the sound of my voice, or anywhere in the country or any other country, that will say that giving you two channels where you have now but one is not an improvement? And when I add to that, that the new channel will require but two lockages in the round trip, while the present channel requires 13 lockages in the round trip, if there is a man who will say that the navigation interests are not benefiting by this scheme if carried out as we propose to carry it out? I do not believe there is, I think it simply has to be studied. It is so obvious that when it is understood no cloud can be thrown across one's eyes so as to prevent them from seeing the effect of it and the benefit to be derived therefrom. Now, of course the question is to whether or not what I say, and what my company say, is feasible or practicable, is largely an engineering proposition. Two years ago this Commission offered to the Shipping Federation of Montreal, the Dominion Marine Association, the Board of Trade, or any other parties interested, the services of engineers, to be paid for by the Government of this country, to look into this scheme, to go to the bottom of it, and to advise whether the proposition was feasible and practicable. Up to the present moment I have not heard that any one of those organizations has taken advantage of that offer; nor have I heard of any engineer differing from our engineers with reference to the feasibility and practicability of the scheme. Now, what are the navigation interests involved, and who are they? I assert, although the Dominion Marine Association some time since did place itself on record as being opposed to this scheme, that the persons interested in the Dominion Marine Association—that is, the users of this channel—are not opposed to this proposition; that this proposition is in their own best interests. Now, let us analyse and see whether my statement is correct, and whether or not I can make good on that point. Who use the St. Lawrence channel? What is the greater user of the St. Lawrence channel between Kingston and Montreal? Practically altogether freight interests. There is but one passenger line doing business between those points—(A voice: 'No') Two? (A voice: 'Two') Then I stand corrected. (A voice: Three.') Mr. Smith's mind would find a great many, I have no doubt about that, but the only one that I have heard anything about is the one that chirped up at that moment.

Mr. SMITH: Would you like the names of the others?

Mr. McCARTHY: Oh, you will get a chance later. I say therefore, that the freighters are the people, the navigation interests, mostly interested in this proposition. Who are they? The one person, I suppose, who controls and manages the greater volume of that kind of business is Mr. J. W. Norcross. He is, as I understand, in control of the management of the Merchants Mutual Line, The Mutual Steamship Company, The Matthews Steamship Company, Jackes & Company, Bickerdike, Limited, Collingwood Shipping Company,. Canadian Lake & Ocean Navigation Company, and the Purdy boats. Now, J. W. Norcross & Co. have written a letter addressed to you which reads as follows:—

J. W. NORCROSS & Co.
Vessel Agents & Brokers,
8-10 Wellington St. E.,
TORONTO, Jan. 31 1910.

Hon. GEO. C. GIBBONS,
Chairman, Canadian Section,
International Waterways Commission.

DEAR SIR,—We have had called to our attention the proposed plans of the St. Lawrence Power Company, Ltd., and the Long Sault Development Company for the development of hydro-electric power at the Long Sault rapids in the St. Lawrence river. We have had these plans explained to us by the engineers and understand that the proposed improvement does not in any way impair the present efficiency of the Cornwall Canal and that in addition to the present facilities which we now have the companies propose to furnish us an entirely new channel with but one lock and that this channel will have 25 feet depth of water and be 800 feet wide, the current not to exceed four miles an hour.

We are vitally interested in Canadian waterways and are operating the largest fleet of vessels at present engaged in the transportation of package freight from Montreal to Toronto and the West and the transportation of grain and other freight from Western points to Montreal.

This new channel with one lock should save our vessels about three hours on each passage up and down as compared with passing through seven locks in the present Cornwall Canal in good weather, but in the event of high winds and very dark nights, it would enable the vessels bound from Montreal west without cargo to navigate in an 800-ft. channel where they whould otherwise be forced to tie up in the present Cornwall canal.

This new channel would give us a double channel through the territory now served by the Cornwall canal and would renew almost entirely the possibility of the St. Lawrence being closed through accident to one of the present seven locks in the Cornwall canal, which in 1908 tied up all traffic on the St. Lawrence for about two weeks.

The development of power contemplated by these companies should locate in the vicinity manufacturing plants which would tend to furnish business for Canadian vessels.

In the last three paragraphs we have given some of our reasons for being in favour of the proposed plan and wish to put ourselves on record as believing that these improvements if successfully carried out are for the best interests of Canadian vessels and Canadian commerce.

Yours very truly,

(Signed) J. W. NORCROSS & Co.

Mr. Smith: The date please?

Mr. McCarthy: January 31, 1910.

Mr. Henderson: Written by Mr. Norcross?

Mr. McCarthy: I did not say so. I said it was written by J. W. Norcross & Co. That is what it is signed by.

Mr. Henderson: Mr. Norcross was in England at that time.

Mr. McCarthy: I think he was in England. I think, Mr. Henderson, you know Mr Norcross's views on this subject?

Mr. Henderson: No, I have had no conversation with him.

Mr. McCarthy: The other large freight interest is represented by Mr. Plummer, President of the Lake Freight Association, who is present and will speak for himself. I understand the freight companies which he represents recognize that this proposed scheme will be of very great benefit to them, and that they are prepared to say so and to place themselves on record to that effect.

Then, Sir, we have the Montreal and Cornwall Navigation Company which has also addressed a memorial to your board, in which they say:—

Toronto, Ont., February 8, 1910.

To the Chairman and Members
of the International Waterways Commission.

Gentlemen,—We, the undersigned, The Montreal and Cornwall Navigation Company, humbly present this petition to you, in regard to the scheme now before you, in connection with the damming of the Long Sault rapids.

We are the owners of several vessels plying on the St. Lawrence river between Brockville and the City of Montreal. We have had an experience extending over twenty years. Knowing the river as we do, we are firmly of the belief that the proposed scheme will not in any way injuriously affect the present navigation of the St. Lawrence river, as we understand the Cornwall canal will remain in exactly the same condition as it now is, while navigation, on the other hand, will be enormously improved owing to the fact that if this scheme is carried through to completion, there will be a lock in the South Sault, which will duplicate the means now afforded by the Cornwall canal for navigation past the Long Sault rapids. We are also strongly of the opinion that the velocity of the current in the Farran's Point and the Big Sny channels will be subsequently lessened, and the dangerous side current now existing at the upper entrance to the Cornwall canal will be destroyed. Duplicate navigation facilities past the Long Sault will ensure shipping interests against delay due to the failure of, or accident in, either the Cornwall, or the South Sault lock. Boats passing the Long Sault will make a round trip in from four and one-half to seven hours less time than at present, which will lessen the cost of transportation of freight from points west of the Long Sault rapids to the City of Montreal.

After the proposed works are constructed, the velocity of the current on the south side of Barnhart island will be very much decreased, and from the experience as we have had on the river opposite and above Cornwall, we know that it will be feasible for boats to use the main channel on the north side of Cornwall island, between Cornwall and the foot of Barnhart island.

We would say further, that in operating our boats between Montreal and Brockville, we meet very much stronger and swifter currents than at Point Moulin.

The freight which is carried both East and West on the St. Lawrence, passes almost entirely through the Cornwall canal, there being no quantity of freight carried through the rapids, consequently any scheme that will cause a saving of hours to vessels passing the Long Sault rapids, must be a great benefit to navigation.

In view of the foregoing, we would say that we are heartily in accord with the scheme, and consider that it will accrue to the benefit of all navigation interests on the St. Lawrence river.

Respectfully submitted,

THE MONTREAL & CORNWALL NAVIGATION COMPANY,
per (Sgd.) 'P. E. CAMPBELL'.
President and Managing Director.

Mr. McCARTHY: I may say Mr. Campbell is here prepared to substantiate what he says in this letter. Then, Sir, we have two other large interests in the way of freighters, one of which is the George Hall Coal Company of Canada, Limited, who writes to you as follows:—

TORONTO, February 8, 1910.

To the Chairman and Members
of the International Waterways Commission.

GENTLEMEN,—The George Hall Coal Company of Canada, Ltd., operates twelve vessels between Lake Ontario and Montreal, and maintains yards and offices in the City of Montreal, in which it is a large taxpayer, having an investment therein exceeding two hundred thousand dollars, and does a wholesale and retail coal business.

We have been familiar with the problems of navigation in the St. Lawrence river for many years, and we have made a careful examination of the projected plans in relation to the Long Sault.

From our inspection of these plans, and from our own knowledge of river conditions, we see no objection to the project, as planned, affecting the general navigation of the river; on the contrary we consider that, offering as it does an alternative route, it would be of very great advantage to all freight shippers in case of an obstruction occurring from any cause in the Cornwall canal. We believe that it would save about eight hours on each round trip that our boats take between the Lake and Montreal by cutting out eleven lockages incident to passage.

Respectfully submitted,

THE GEORGE HALL COAL COMPANY OF CANADA, LTD.,

per (Sgd.) W. C. KELLVEY,

Agent for the purpose.

Mr. MCCARTHY: Then there is the Ogdensburg Coal and Towing Co., who writes as follows:—

OGDENSBURG, N.Y., February 8, 1910.

To the Chairman and Members
of the International Waterways Commission.

GENTLEMEN,—The Ogdensburg Coal and Towing Co. operate sixteen freight boats in the St. Lawrence river between Lake Ontario and Montreal, and in connection with our business we operate a large wholesale coal business into the city of Montreal, and have a considerable investment in the city of Montreal, and have been so engaged for a period of thirty years. We are further allied with the Daly & Hannan Dredging Company, and have thus for many years made a special study of the channels and currents of the St. Lawrence river.

We have fully examined the proposed plan of the St. Lawrence Power Co., Ltd., and are of the opinion that the proposed development will not only be no detriment to the navigation of our boats, but will on the contrary constitute a substantial improvement.

We are members of the Dominion Marine Association, and desire to go on record as being in favour of this proposed development. The proposed development will leave unimpaired the present route through the Cornwall canal, and will give another route in the event of obstruction, repairing or enlarging of the Cornwall canal.

Respectfully submitted,

THE OGDENSBURG COAL & TOWING CO.

per (Sgd.) JOHN HANNAN,

President.

Mr. MCCARTHY: Now, I may say that the representative of the George Hall Company and Mr. Hannan himself are here, prepared to substantiate what they say in those letters. It was thought more convenient to put their views in that form in order that we might save time and have lesser number of speakers. Then I will read a letter signed by James Playfair, President of the Midland Navigation Company, Ltd.:—

MIDLAND, Ont., February 1, 1910.

Hon. GEO. C. GIBBONS, Esq., K.C.,
Chairman, International Waterways Commission,
Toronto, Ont.

Re SOUTH SAULT CHANNEL.

DEAR SIR,—I understand there is a meeting in Toronto on February 8, of the different interests to discuss the power development at the Long Sault rapids. In the past all our business has been on the upper lakes, but if certain negotiations go through I expect to run some of our boats to Montreal. At present I am unable to say what effect the development of the Long Sault Rapids would have on navigation, but from what I can find out I do not think it would make any difference to freight boats using the St. Lawrence. In fact, I think it would be a benefit as one lock would be used as against seven at present. So this would make a difference to a boat of six or seven hours on the round trip.

Anything that can be done to improve navigation between Port Colborne and Montreal making it safer and quicker is in the interests of the vessel owner.

Yours very truly,

(Signed) JAS. PLAYFAIR.

Mr. MCCARTHY: I have thus given the views of the Norcross interests, the Ogdensburg Coal and Towing Company, the George Hall Coal Company, the Cornwall and Montreal Transportation Company, and the Midland Navigation Company—if it makes this arrangement to run its freight boats to Montreal —and taking it for granted that Mr. Plummer himself represents and also, as I understand the MacKays of Hamilton and Mr. Jacques of Montreal, to have practically all the freight owners using that route, with the exception of my friend Mr. Henderson's line. All of those freight owners, owners of vessels carrying freight—I speak under my instructions—have looked into this scheme and approved of it as a betterment to navigation; that is to say, providing that the necessary safeguards are furnished, that the interests of the country are protected and that the scheme as outlined by us is carried out. Now, as to my friend Mr. Henderson, I don't quite know exactly what his position is, he is here and will speak for himself. I have understood, however, that he is of the opinion that if this work can be carried out as we suggested, undoubtedly it would better the navigation facilities at that point; but he has some idea that possibly the interests of Canada will not be fully protected. Well, as to that, sir, I am content to leave it with you and the Government of this country who are our protectors, and who no doubt will see that no contract is entered into or franchise or right given wherein Canada's interests are not fully protected. As I say, practically the freight owners on the St. Lawrence route are unanimous that this will better navigation facilities at this point. It is obvious as I have said, that that must be so. We preserve for them the only route they have now, and we offer them another one. Can there be any answer, from the freight-owners standpoint? It seems to me it must obviously be so. Now, that being so, we have to deal with the Richelieu and Ontario Navigation Company. True, it uses the rapids, and has used them for a considerable length of time, that is to say, on its eastern trip; on its west-bound trip it must, like all other boats, use the canal, so, if there be deprivation there, it simply prevents one boat of that company per day for a period of three or four months from running these rapids, carrying their passengers. We say that the giving of that lock will not delay them; that they can make their time just as well by passing through that one lock as they can by passing the rapids. In answer to their scenic objection we say we are not going to deprive them of the assét they say they own in the shape of the Long Sault; we say we are going to give them something better to look at. You have the other rapids down the river which your tourists will see, and we are going to give you a dam forty-feet high, with ten feet or so of water running over it, which will be something to look at, and which tourists will come to look at. Now, that is the navigation situation so far as users of that channel are concerned. Can there be any answer to the statement that navigation will not be prejudicially affected? You are getting two channels where you have but one; and I leave it at that. Now, what are the further interests that may or may not be affected? We understand that the Shipping Federation of Montreal and the Board of Trade of Montreal are represented here. They have been heard before this Commission previously. They have with one acclaim and one voice said that so long as the level of the water at Montreal is not affected, that is as far as Montreal and east of Montreal are concerned, that they have no interest. Now, sir, I state as a fact that the engineers of the Government, after conferring with our engineers, agree that the elevation of the water in the harbour of Montreal will not be affected in any way whatsoever by these works; that in the event of failure of these works Montreal would not be affected; that the level of the water in Montreal harbour would not be affected. The Shipping Federation of Montreal may rest assured of this fact, that the Government have from the first, and the Waterways Commission likewise from the first, have said that the navigation interests are paramount; you must be certain you are not going to interfere before this work can be permitted. There has not been one title of evidence given that the level of the waters below these works will be detrimentally affected by them—not one title, sir. So that I say to the Shipping Federation of Montreal, the Harbour Commissioners of Montreal, the Board of Trade of Montreal, that they will not be prejudicially or detrimentally affected in any way whatsoever; that they will be benefited. If you want to bring shipping to your port, if you want to bring business to your city by the channel of the St. Lawrence from the West, the better facilities you have on it the more business you are going to bring. There cannot be any answer to that. Conceding, as I do concede, that navigation interests are paramount, how are the Shipping Federation of Montreal, the Board of Trade of Montreal, or the Harbour Commissioners of Montreal to be affected at all unless it be that these works will affect the water there. If they do not affect the water, you cannot have one word of complaint, but on the contrary you must have words of approbation. The larger places that grow up continuous to Montreal and in that locality must be a benefit to you. The development of this large power close to Montreal must be a benefit to Montreal. It may not be to the Montreal Light Heat & Power Company; I don't know as to that; but as to the Montreal people and their interests, if you want large manufacturing localities close to you, here is one means of getting them. We do not ask them if they are going to prejudice navigation interests; we do not ask it if navigation interests are not paramount, we all admit and we concede that they are; but we say to you that not only do we not detrimentally affect navigation, but we vastly improve it, and will make the trade and commerce of your city more than it is to-day, because the facilities will be better. A deep-draught boat can go through this lock of ours, whereas it cannot go through the present Cornwall canal. There is an agitation on at present to deepen the Welland canal, to spend the country's money in deepening that. If that is going to be deepened in order to let vessels of large draught come to the City of Montreal, how much benefit will this proposed improvement be to you? Do you realize the benefit to you of having your vessels go through one lock, thus saving the deepening of the Cornwall canal to make it equal to the Welland canal? Now, I cannot say more to these gentlemen who represent the different interests of the City of Montreal. I do say that the Goverment engineers have found that the elevation of the water at Montreal will not be affected by these proposed works; that the water in the channel east of Montreal or west of Montreal up to our works or beyond our works will not be detrimentally affected. Now, what are the other interests? We have in the province of Ontario a large development of power in western Ontario. The evidence of it is seen if anybody cares to travel through it. Manufactories are growing up there. Where there was, in a measure, stagnation, there is now a development of manufacturing industries. Eastern Ontario has been robbed by western Ontario, because western Ontario has got power and eastern Ontario has not got power. I say that the people along the Long Sault locality—Brockville, Cornwall, Morrisburg and all those places—will be benefited as the Niagara Peninsula has been benefited by the development of this power. The people of Brockville recognize it. They are here to-day some 20 or 25 strong, the most reputable and influential citizens. The people of Cornwall are here today, represented by my friend Mr. Pringle and Mr. Campbell, asking and insisting that this work be allowed in order that they may have power at their door which is equivalent, as I said, to opening a coal-mine at their door. Now, what is the reason that this should not be granted? There does not seem to me to be one reasonable answer made to the situation that these two companies should be permitted to unite their efforts to develop power at this point. If it is demonstrated that navigation is interfered with prejudicially it is granted that under the ruling of this Commission and the ruling of the Government this work cannot be permitted. But in the absence of that, is there one title of evidence, is there one reasonable argument suggested, that these works should not be allowed to progress and this power developed for the good of the people of eastern Ontario? It is said that we should be alive at this moment to the conservation of national resources. Grant that we should; how do you conserve a water-power? By letting it run to waste for ever and anon? You conserve timber by keeping it standing; you conserve coal mines by keeping them from being wastefully operated; but how do you conserve a water-power? In only one way that I can suggest, and that is, by the utilization of it. If you have water running to waste you are not conserving it by letting it go on running to waste for ever. Surely it behooves a progressive mån, a man who desires to build up his country, to utilize that which God has given him in the shape of water-power; and utilization is the only method of conservation that I know of—and that is what we want to do at this particular point. Don't imagine, Mr. Chairman and gentlemen, that we for one moment desire to do this for nothing. We are prepared to negotiate, we are prepared to deal with the people that own this place. We are prepared to arrange upon what would be a fair and equitable basis to deal with anybody in respect of this power. Now, there has been a great deal of clamour lest you in the discharge of your duty, and the Prime Minister and his Ministers in the discharge of their duty, would allow a lot of rapacious Americans to come over to Canada and carry away, holus bolus, all we have got. Never has such proposition been submitted; never for a moment. There has been a fair deal, a fair negotiation. All we ask, and all we want is a fair and reasonable and equitable division of the power developed at this point by the two companies. Now, sir, if I could say anything more that would make this fair and reasonable proposition I would be pleased to do so; but I have sought to answer all I have heard, all that is in the air, all that has been said, because it is not founded on reason; it is attempted to be founded upon prejudice. The sentiment of Canadians has been appealed to. It has been said. 'You are robbing me, a Canadian, of my heritage." Well, we of Canada have a heritage, true, and we are proud of it; but if we have a heritage that we are proud of, how much more pride can we have in that heritage if we use it and develop it and build up cities and manufacturing industries? But, as the Chairman said when he spoke two or three years ago, is this a heritage that belongs entirely to Canada and to Canadians? From Ogdensburg to below Cornwall on the south bank of the St. Lawrence river is the American nation and the American country. The international boundary at those points is much closer to the Canadian shore than to the American shore. But let us assure an even division all along that long distance; is not the St. Lawrence river at those points the common heritage of the two nations? There is no right, as the Chairman says, in the water; there is a right of user; and all we ask on behalf of these two companies is to be permitted to use these waters for the development of both countries, for the benefit of the Canadian people and the American people; to build up American people; to build up American interests, to build up Canadian industries. Now, sir, I would ask you to hear Mr. Rickey, who will simply outline technically the scheme of these two companies.

Chairman Gibbons: As the Commission has never had any of those letters, or heard of them, I think they should be filed.

Mr. McCarthy: Certainly, Sir, I intend to file them,—Mr. McCarthy then handed to the Secretary of the Commission the letters and memorial which he had read.—A large map having been placed on the wall.

J. W. Rickey, Engineer for the St. Lawrence Power Company and the Long Sault Development Company, said: Mr. Chairman, Members of the Commission, and Gentlemen: I show on the map here the general outline of the plan proposed for developing the power of the Long Sault rapids. This plan is somewhat like that which was shown you about two years ago, particularly those parts that lie south of the international boundary line, which I will trace out with my pointer. (Tracing boundary line) South of that line the works as outlined to you two years ago are the same. North of that line they have been changed. The plan now proposed contemplates maintaining absolutely the integrity of the Cornwall Canal. As Mr. McCarthy put it, it will not be interfered with in any way, no matter what happens to these works. Assume for the sake of argument that the dam should wash out, the Cornwall canal will not be interfered with at all. I wish to make that point very clear. Most of you are probably somewhat familiar with the location of these islands. (Pointing out Long Sault island, Barnhart island, Sheek island). The Cornwall canal lies on the north side of Sheek island. This is the single lift-lock to which Mr. McCarthy referred when he said the boats would save from four to seven hours time on each round trip and avoid eleven lockages, there being required two lockages for each round trip in going through the South Sault lock, whereas there are thirteen now required in going through Cornwall canal and Farran's Point canal. If these works are completed a dam will be built from the foot of Long Sault island to the head of Barnhart island. This is merely a diversion dam to deflect the water from the site of the present rapids down to the foot of Barnhart island, where the powerhouses will be built. The channel between Barnhart island and Sheek island, known as Little river channel, will be deepened and widened; the ultimate width will be about a thousand feet. At the foot of Barnhart island will be built a dam, between the American shore, which is on the island, and the Canadian shore; and adjoining this dam will be built a powerhouse opposite Lock 20. A canal will be excavated across the foot of Barnhart island, and one, or possibly two powerhouses, will be built at this point. I call particularly to your attention that we are following absolutely the fundamental principles of natural conservation of nature's resources in that at the inception of this plan we have provided for ultimately developing all of the power that is available at this point. Probably—almost inevitably—we

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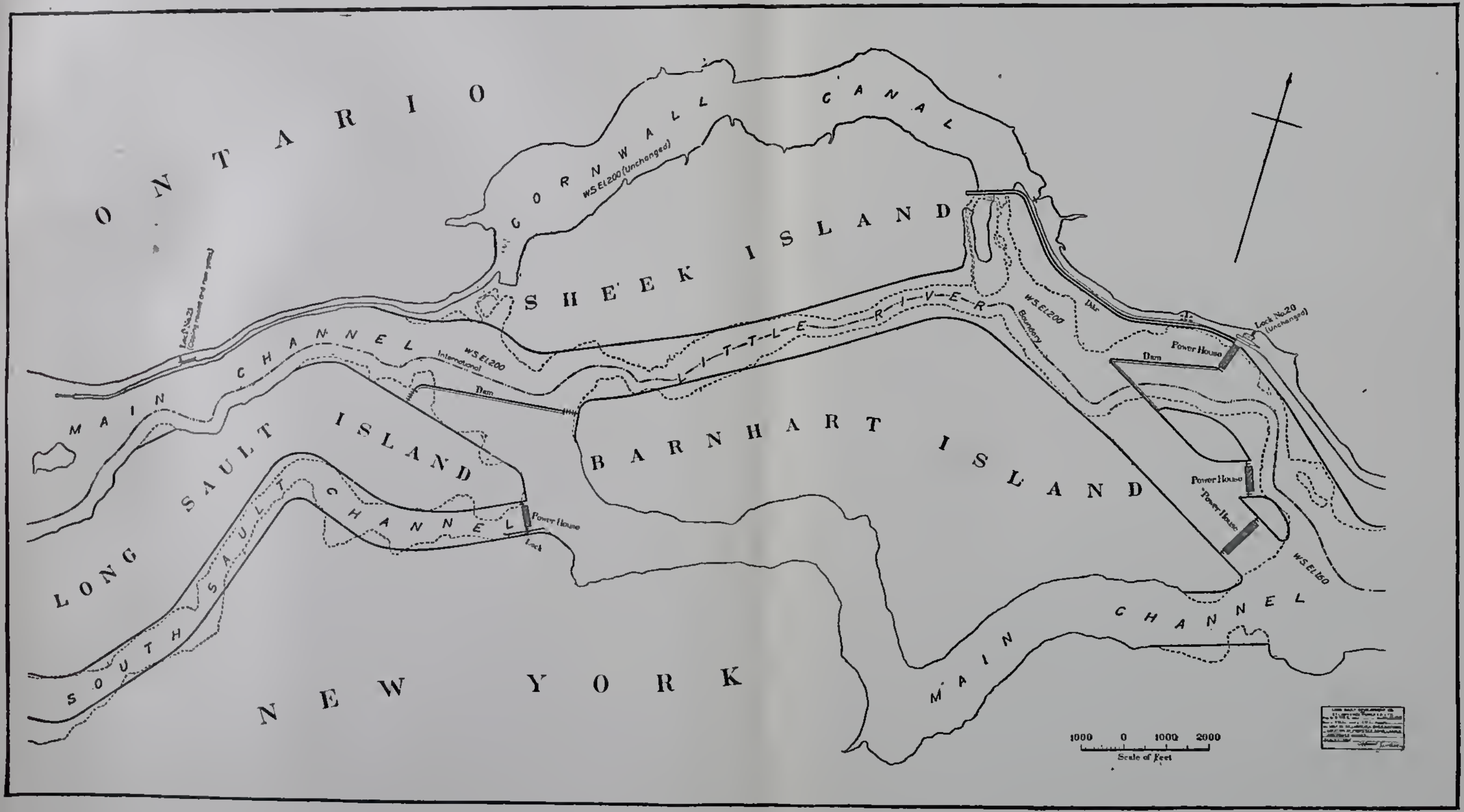
Long Sault Development Co. and St. Lawrence Power Co., Limited. Drawing No. E.-138-X. December 28th, 1908. Drawn by J. W. L. Traced by J. W. L. Scale. 1″=500′



Map of the St. Lawrence river showing location of proposed dams, canals and power houses according to plan prepared by Engineer J. W. Rickey on December 28, 1908, and presented by him to the International Waterways Commission at its public hearing in Toronto on February 8 and 9, 1910.

will all be dead then, for it is a long time in the future, but our grand children will be able to see the day when all the power available at this point can be developed.

Chairman GIBBONS: How much horse-power?

Mr. RICKEY: There is approximately 600,000 horsepower available at this point, and for that reason I say one, or possibly two powerhouses to be built at the foot of Barnhart island. Little River channel will be used, under the amended plan, really as a power canal; under the former plan it was to be used as a ship canal. That, briefly, gives a general description of the plan. Now let us see what results will follow. The South Sault channel will be widened to about 600 feet in width. There should be a minimum depth of twenty to twenty-five feet of water throughout the entire length of this channel. Boats coming down the river, instead of passing on the north side of Croll island, will pass to the south of it and across to the site of the present Dodger's shoal, which will be removed to a depth of 30 feet, and then coming down this channel. It is not a canal; it will be a river channel 600 feet wide, and boats will come down that channel, pass through a single lock, and down through the river. You may say that the current is too swift on the south side of Barnhart island for the boats to come up the channel. That is not the case. Ninety-five per cent of the total volume of water in the river, having passed through the rapids and through the South Sault channel, passes on the south side of Barnhart island inthe main channel. The upper dam between the foot of Long Sault island and the head of Barnhart island and the lower dam, having about the same length, will discharge approximately equal quantities of water; consequently we divert half of the water that now flows past the point indicated by my pointer through Little River channel, and as the water on the south side of Barnhart island is now approximately 60 feet deep—40 feet deep the entire length of the island—the depth will be decreased very little, and hence the velocity will be cut in two. In other words, where there is now an 8-mile current on the south side of Barnhart island there will be only a 4-mile current, and all boats of every kind on the river can go against a 4-mile current with their tows; otherwise they can't get up the river at all.

Mr. HUTCHESON: What is the present width and depth of the South Sault?

Mr. RICKEY: That is pretty hard to answer, because sometimes it is only seven or eight feet deep at Dodger's shoal. It is about a thousand feet wide at that point. There are other places where it is a thousand feet wide and forty or fifty feet deep. What we will provide at the South Sault channel is a canal 600 feet wide with a minimum depth of at least 25 feet. When these dams are built the water opposite Lock 21 will be raised about 2 % feet. The average depth of the river at this point is about 25 feet. In other words, we will only increase the depth of the water about $10\frac{4}{10}$. We will reduce the velocity of the current in inverse ratio, or about 10%. There is, however, at the entrance to the Cornwall canal a dangerous side draught, so that the tows coming down stream meet boats coming up stream at the entrance to the canal, those going down stream have a dangerous passage there, and to the extent that we raise the water at this point, so will we decrease that side-draught and improve navigation. Another point that is of vital interest: just above Lock 20 there is a difference of 35 feet head between the level of the water in the canal and the present river level, indicated by my pointer. When the dams are built and the water is raised to the same level at the head of Sheek Island as now exists in the Cornwall canal, north of Sheek island, likewise we will have the same corresponding level just south of the Guard-Lock in the Cornwall Canal. All danger of wash-out of the banks of the Cornwall canal between Locks 20 and 21 will be forever removed, and that is a very important point. There was a wash-out some years ago at this point. I can show you a place in the Cornwall canal where the bank is so soft that you can poke a stick down in it five or six feet without pressing very hard. There is another place where there is a leak in the bank of the canal just below Lock 20, and a barrel has been set in the bank, and that is where the cows get their daily drink. I think in general that the rivers—

Chairman GIBBONS: Tell us approximately how much power would be developed by the Canadian company, and how much by the American company.

Mr. RICKEY: I call to your particular attention the relative location of the Cornwall canal at this point, and the international boundary line—this broken line indicated by my pointer— and how this boundary line lies within 500 feet of the Cornwall canal at this point. We propose building as large a power house in Canada as can be built, and that powerhouse will have about 100,000 h.p. capacity. In order to do that we excavate a very high knoll at the north easterly end of Barnhart, cutting back some 800 feet from the shores in order to give passage-way for the water coming over at that point. Answering your question directly, then, this powerhouse, which will be as large as we can make it, will have about 100,000 h.p. capacity.

Chairman GIBBONS: Then the amount of the development on the American side will in the end be about six times as great; is that the position?

Mr. RICKEY: About five times as great.

Chairman GIBBONS: So that if we are to have an equal division of the power some special arrangement will have to be made whereby Canada will share in the distribution of the power on the American side?

Mr. RICKEY: Yes sir, and that is caused solely by the relative location of the international boundary line which of course cannot be shifted, and the Cornwall Canal which we cannot interfere with.

Commissioner STEWART: Would it be possible to put the dam in any other place, so that the power could be more evenly distributed?

Mr. RICKEY: I have made quite a number of studies and spent considerable time on that, and have been unable to devise any location that is better than this, that will accomplish the purpose that you just mentioned.

Chairman GIBBONS: What about damming at Cornwall Island lower down? By putting the dam there, it it were feasible, there could be about an equal distribution on both sides, could there not?

Mr. RICKEY: Yes sir, but there is no ledge there; there is no foundation for dams. When the Cornwall bridge pier washed out two years ago they made borings there to locate a new pier, and I think they went down something like 75 feet below water without striking ledge. I omitted to mention that all these structures—the power house as well as gates, retaining wall, and everything—will rest on a solid limestone ledge. There is no soft foundation anywhere. We have spent a great deal of money to determine the location of those ledges.

Commissioner CLINTON: Does the location of the power house on the American side of the boundary-line or the Canadian side of the boundary-line have the slightest effect on the distribution of the power between the two countries?

Mr RICKEY: Not that I can see.

Chairman **Gibbons**: There is a point there that might be borne in mind; it is one of the matters that will have to be taken care of if the principle of the Commission is carried out—and I answer it now because it has to be considered by the promoters of this scheme if it is carried out. Each country has the right, without an absolute arrangement, to prohibit the export of power; and if these powerhouses are on the American side there is no power in Canada that can compel them to distribute power in this country. There would have to be some special arrangement if the principle of equal division is to be carried out in this place.

Commissioner **Clinton**: Allow me to correct you. In the United States we cannot impose export duties.

Chairman **Gibbons**: I am very glad to hear it. I had overlooked that. We have that power.

Mr. **McCarthy**: We have exercised it, too.

Chairman **Gibbons**: You may acquire it in the long hereafter. I think it is just as well to provide for it.

Mr. **Hilliard**: I would like to ask Mr. Rickey the fall from the new lock to Cornwall in the south channel.

Mr. **Rickey**: About 18 feet total.

Mr. **Hilliard**: How can you slow the water, even if you divert some of it, in an 18-ft. fall?

Mr. **Rickey**: I understood you to mean as it is to-day. Do you mean under future condition?

Mr. **Hilliard**: Yes.

Mr. **Rickey**: If you let me get to my charts I can tell you that exactly. (After consulting charts). It would be 11 feet.

Mr. **Hilliard**: Anybody who knows anything about drainage would know that that is a tremendous fall, so that that point of decreasing the current one-half in the south Sault is certainly controversial.

Mr. **Rickey**: Yes sir, but you must understand the hydraulics of the St. Lawrence river. There are places, for instance through Farran's Point channel, where there is a fall of four feet in a distance of a mile, and the boats go right through it. Here is distance of nearly twelve miles.

Mr. **Hilliard**: Not twelve miles from there to Cornwall?

Mr. **Rickey**: There is something like three and a half down to the foot of Barnhart's, and from the foot of Barnhart's to Cornwall at the lower dock is, I would say 4½ miles.

Mr. **Hilliard**: The answer to that is this, that in Farran's Point they take the cross-current. Anybody rowing on the river does that. What we say is that that is one of the controversial points, especially looking at the crookedness of the channel.

Mr. **Rickey**: If we get to discussing back-water and velocity and everything we are not going to get anywhere in this meeting. I have all my computations and data, which I will be only too glad to give to the Commission.

Mr. **Rucker**: What is the speed of the current between Cornwall island and Cornwall? Have you that determination?

Mr. **Rickey**: The average velocity from a point opposite the middle of Pelly's Gut to the point opposite the west boundary of Cornwall is 3 7-10ths miles per hour. The average velocity from a point west of the boundary of

Cornwall to a point opposite Lock 15 is 4 18-100ths miles per hour. These points were determined by allowing a boat to drift down the stream on a calm day, and noting farm houses, bridges, and other prominent points, and plotting them on a map, and computing the distances and the time against the rate.

Mr. LAFLEUR: When were those computations made that you have in your hand?

Mr. RICKEY: I cannot give you the exact date without refering to my notes. It was about September, 1907, when that drifting test was made.

Mr. LAFLEUR: Were those accepted at any of the meetings of the International Waterways Commission?

Mr. RICKEY: I cannot answer that. I don't remember.

Mr. LAFLEUR: As far as I am instructed, the only thing that was shown was the blue print which is on the table there.

Mr. RICKEY: I referred to that blue-print to refresh my memory. We have spoken about the velocities of those currents and threshed that matter all over.

Mr. LAFLEUR: You said the only new feature in your present project was that you were conserving the Cornwall canal. I understood you to say that that is the new feature in the project as at present submitted.

Mr. RICKEY: I did not want to take the time of the meeting to-day to explain where this plan differs from the original plan, so I just said briefly that south of the boundary-line the plan was the same.

Mr. LAFLEUR: Does it differ materially from the old project, apart from the conservation of the Cornwall canal?

Mr. RICKEY: Oh yes.

Mr. LAFLEUR: In many respects?

Mr. RICKEY: Not in many respects. The location of the Canadian power-house is just as it was before. I can indicate, if you wish, just where the changes are. Perhaps I will do that; it will only take a moment. Under our original plan, Little River channel was enlarged just as it is here. Then we asked permission to cut out the dam at the west end of Sheek island—to cut out the dam at the east end of Sheek island—and to build a lock between the Cornwall canal and the Little River canal, so called, each at a point about one mile west of Lock 20. Other than that, this plan is the same.

Mr. LAFLEUR: The old project that you have just been describing was abandoned a long time ago?

Mr. RICKEY: That was abandoned, yes, quite a considerable—

Mr. LAFLEUR: It was abandoned when the Commission held its sitting in Toronto in November, 1908?

Mr. MCCARTHY: No, it was not.

Mr. LAFLEUR: I see that Mr. McCarthy stated there that there would be two methods of going up and down the river; the boats would use the Cornwall canal as well as the South Branch—just the same as you are proposing now.

Mr. MCCARTHY: That is identical.

Mr. RICKEY: That is what I say now; you can always use the Cornwall canal just as you do now; you can also use the South Sault under the proposed plan; giving two alternate routes, so that no matter what happens to the Cornwall canal the navigation of the St. Lawrence will not be interfered with.

Mr. Lafleur: You recollect that at that meeting in November, 1908, you undertook to prepare further plans and data?

Mr. Rickey: Yes, sir.

Mr. Lafleur: Did you prepare them?

Mr. Rickey: Yes, sir.

Mr. Lafleur: And did you furnish them to any of the interested parties?

Mr. Rickey: Yes.

Mr. Lafleur: Will you tell me what you furnished?

Mr. Rickey: I furnished a general outline plan such as this.

Mr. Lafleur: Could any engineer criticise that plan?

Mr. Rickey: A competent engineer can.

Mr. Lafleur: You think that from that plan—which is, I suppose, just an enlargement of the blue-print—any engineer could say whether these works were feasible and were likely to interfere with navigation?

Mr. Rickey: Any engineer who knows the site can take that plan and say whether or not it is feasible.

Mr. Lafleur: How was that plan made? Was it made by surveys on the ground?

Mr. Rickey: Yes.

Mr. Lafleur: Is that your plan?

Mr. Rickey: Yes.

Mr. Lafleur: And is that the same as the blue-print that has been handed to us?

Mr. Rickey: Exactly. It is off the same negative.

Mr. Lafleur: You say from that plan or the blue-print any competent engineer could make up his mind as to the feasibility of the scheme, and as to interference with navigation?

Mr. Rickey: Knowing the characterictics of the site, mind you.

Mr. Lafleur: Then the characteristics of the site are not indicated on the plan?

Mr. Rickey: You have to have a general knowledge of the location.

Mr. Lafleur: Are the currents shown on that plan?

Mr. Rickey: No.

Mr. Lafleur: Or on the blue-print?

Mr. Rickey: No.

Mr. Lafleur: Are the heights shown?

Mr. Rickey: No.

Mr. Lafleur: Will you say that without knowing these features a competent engineer can make up his mind either as to the feasibility of the scheme or as to its interference with navigation? He would have to know those features; he would not get them from your plan or from any material that you furnished?

Mr. Rickey: What we submitted was the general plan showing the proposed arrangement, and that is what you see on the walls here.

Mr. LAFLEUR: Mr. Chairman and Gentlemen of the Waterways Commission, I may say that I appear on behalf of the Board of Trade in Montreal, and I will have the honour at a later stage of the proceedings of submittting to you our view on the subject. I may say incidentally that I do not represent any private interests, and that we have endeavoured to look at this matter in a dispassionate way, and as broadly as possible, but that so far we have been hampered by the lack of sufficient information as has been furnished us. I am instructed that that information is wholly inadequate to enable them to make up their minds either as to the practicability of the scheme in the crude form in which it is presented, or as to the possible dangers to navigation, and as to the results in the way of flooding the lands, etc. While my friend Mr. McCarthy imagines that we are merely concerned with the level of the water at Montreal, I must remind you, Mr. Chairman and gentlemen, that we take a wider view of our duties and responsibilities. We think that the welfare of Canada is the welfare of Montreal, and that anything that interferes with the navigation above us as well as below Montreal is of the highest interest to our citizens, as it is to the country at large. Therefore we are apprehensive that, for lack of information which has been asked for again and again and as we think has never been furnished—

Mr. McCARTHY: What do you mean by 'again and again'?

Chairman GIBBONS: I should like that General Ernst, the engineer of our Commission, would be present when these criticisms are made. I like yourself, am a lawyer. I understand that all this is subject to the approval of the Government engineers of both countries; that this Commission will not attempt to deal at present, and is not dealing at all, with any particular plan. I quite see your point, that whether any plan is feasible may depend upon some of those questions that you have asked. That matter has been considered by the engineers connected with our Commission, but the details and the working out of the condition are all subsequent matters entirely. The first question is: Is it permissible at all, under these conditions, to make this development? The general question is now being dealt with. Certainly the engineers of both Governments will have to consent and approve, and possibly this Commission will approve of any plan and details.

Mr. LAFLEUR: I quite appreciate what has just fallen from you Mr. Chairman, but it does seem to me— and I am so instructed by competent engineers—that the details are of the very essence of the matter; that you cannot say whether or not the proposed scheme is going to interfere with navigation, or is going to injuriously affect the property situated above the proposed development, unless you have a detailed plan giving the praticulars that are necessary in order to arrive at a conclusion. It does not seem to me to be merely a matter of detail to be settle afterwards. It seems to me to be of vital importance to settle the project. I am not alone in this view. I have consulted with various interests who are more or less opposed to this scheme, and I understand that we are unanimous in feeling that up to this time we have not got the information that is necessary to enable us to offer any written criticism on the plan. You recollect that my friend Mr. McCarthy said a moment ago that no engineer has been heard of who makes the slightest objection to the feasibility of the scheme, or who pretends that navigation is going to be interfered with. Well, how can an engineer do that until we have got the information we are now seeking? And I would like to draw your attention to what passed at the last meeting, where that very request was made, and where an understanding was arrived at that this data should be furnished; and we have been waiting ever since for this data. And I take the liberty, if I am not occupying too much time, to refer to pages 42 and 43 of those proceedings, where Mr. Rickey admitted that he had not the particulars.

At this juncture, 4.15 p.m., General Ernst and Professor Haskell arrived and took their seats.

Chairman GIBBONS: Now that we are all here, I will have a chance to talk to General Ernst in relation to the matter you speak of, Mr. Lafleur. The gentlemen who were at Montreal will bear with me that I was very strong in pressing the suggestion that the boards interested appoint engineers; and I at that time obtained the consent of the Government to pay the expense of any such experts out of the public funds. That offer was not availed of, perhaps for perfectly good reasons; but now that we are here I think we had better let the discussion go on. I think it would be very unfortunate to block the proceedings at this time. I think it would be better to go on and hear what the people have to say in regard to this proposition.

Mr. LAFLEUR: I agree with what you say, Mr. Chairman, I am not alone with this view. The Toronto Board of Trade are in the same position as we are. They are quite desirous of giving a dispassionate consideration, in the interests of the public purely but they have been quite unable, from the material so far supplied, to arrive at any conclusion. I think the President of the Toronto Board of Trade, who is here, will accord with what I say—that we have been experiencing serious difficulty in consequence of the present condition of the project, which does not seem to me, as far as I can judge from the remarks, to have advanced one step since the meeting of November, 1908. I have read what passed at that meeting, what was undertaken to be furnished, and I say that nothing of that kind appears to have been done.

Mr. McCARTHY: That is not correct.

Chairman GIBBONS: That is just not true in this sense: They have in the meantime supplied to the engineers of the Government the three leading engineers, these plans. They have reported to the Government in regard to that. It is perfectly true that as far as this Commission is concerned we have heard nothing of it for some time. The matter was sought to be brought up at Buffalo, and was adjourned here; but all these matters will be dealt with, I think, by my friend General Ernst much more ably than Mr. Clinton and myself—for he is also a lawyer—will be able to deal with them. I think if we would hear the gentlemen who are present, deal with the general proposition in the meantime, it would be more satisfactory.

Mr. KING: In deference, Mr. Chairman, to what has fallen from your lips, I think I ought to keep my seat; but in order that my clients may enjoy what is said, I ought to say a word. General Ernst will probably be able to bear out what I say in regard to the understanding at the meeting in the King Edward Hotel, in 1908. At that time we were in the identical position that we occupy to-day with the one exception, so far as I can gather in the last fifteen months, that the second canal, that is now to run north of Sheek island, was to be diverted into the Little River on the Canadian side. At that time it was very clearly understood over the table, and it is on the record, that plans and details of the fullest nature were to be laid before us so that we could avoid this discussion which the Chair is now anxious to avoid; and until this date we have not one data of information that gives us what we wanted. We had that plan, and I had a little pamphlet with some letter-press in it which did not even tell me whether the Farran's Point canal was to be obliterated or was to remain. I think we may be quite satisfied on all hands if we treat the present meeting as one for the purpose of eliciting that information. Then if so, let me refer to something said by Mr. Rickey a minute ago. The question was asked as to whether or not the current or the depth at any certain point would be altered, and he said it was very unfortunate if a discussion would go on at this stage. Now, it should either go on the record or we should be supplied with that information so that we could make our case for or against. With reference to Mr. McCarthy, I think he misunderstood our position to some extent. It is information that we are seeking. We are not all dead-set against this thing. There are freight interests that might think it was a good thing; but we want information, and if this meeting could adjourn for the purpose of getting the information and then could decide, it would be well.

Mr. WATSON: I wish to join with Mr. Lafleur in the view he has expressed. I understand—if I am not quite accurate you can correct me, no doubt—that the object of this meeting is to enable your Commission to inquire and to report to the Governor in Council as to the feasibility of this commercial project in the proposition to dam the waters of the river.

Chairman GIBBONS: Not in detail.

Mr. WATSON: Well, the feasibility of the proposal and we are kindly invited by you to attend and to state our views. Of course the feasibility or non-feasibiliy of it depends very largely, in fact almost entirely, upon the proposal itself, and without the particulars and details of that it is very difficult for us to do justice to our clients or to ourselves in endeavouring to state an answer. You, Mr. Chairman, know that in Court procedure we require, particularly in answer, that the full case of the other side should be stated before we are called upon to answer. Now, is it not so that in this matter, which is one of very great importance, vital importance to many interests, we should be fully seized of all the facts and details to enable us faithfully and properly to present an answer which may be of advantage to you and to your Board in reaching a conclusion? I would, therefore, respectfully submit to you, Mr. Chairman and gentlemen, that the further consideration of the matter should be postponed until those details are presented to us, and we have had an opportunity of examining them, and having the advantage and benefit of engineering skill, so that we may present the circumstances and facts to you in a proper and intelligible way.

Mr. SMITH, K. C.: I take it, Mr. Chairman, that we are invited here in order to represent fully to you the various interests that are probably affected by this scheme. Now, if we are not furnished the information which in the most formal manner was promised to be furnished, I say it is quite impossible for any interest to state its position before this Board.

Mr. MCCARTHY: What interest do you represent?

Mr. SMITH: I represent specially the Richelieu and Ontario Navigation Co. Mr. John Kennedy is an engineer who as had, I venture to say, more experience as to the action of moving water and as to the action of ice, than any other; and Mr. John Kennedy this very day informed me that no engineer lives who could form any opinion whatever or give any rational statement of his position upon the information that is furnished up to this date. Mr. Kennedy is in the room.

HON. ADAM BECK: Mr. Chairman, representing the province of Ontario we find ourselves in a position very similar to that of the gentlemen who have addressed you. We have to-day no detail or description of any kind that will enable our engineers to look into the matter as to the effect this project will have on the shores of the province of Ontario. You were kind enough to give me a map, I presume a copy of the blue-print before us, and one other, and some description of the undertaking, which I submitted to the engineers of the Hydro-

Electric Commission. They reported that they were unable, with the information at hand, to give any definite statement of what it would mean to the province. Of course the province has other contentious questions to bring before you. We object seriously from a provincial standpoint; in fact we have not been considered, Mr. Chairman, though I believe the state of New York was considered by the United States Government. We have not had that opportunity of looking into the matter whatever ; therefore I wish, without any intention of delaying or blocking the meeting in any way, to make this statement on behalf of the province.

Mr. HILLIARD: I wish to state that I hold a brief for the Ontario Government on those contentious questions. I do not know that it is opportune to discuss them now, but I wish before the session closes to have an opportunity of entering the protest of the province in relation to what Mr. Beck has hinted at.

Mr. CUMBERLAND: On behalf of the City of Toronto I would say that the Board of Trade, representing not simply the City of Toronto but a large membership from all parts of the province—from Chatham, Walkerville, London, Woodstock, Guelph, Hamilton, Brockville and other points—desire to join in the protest which has already been placed before you. In 1907 the Board asked for the fullest consideration, and expected to have the plan submitted to them. Upon receiving the notice of this meeting a request was made to your Board for the submission of those plans.

Chairman GIBBONS: I never heard of it.

Mr. CUMBERLAND: The reply was that plans might be obtained from the promoters, but in all probability not in time for this meeting. But practically in the meantime nothing had been done; it was the same old proposition which would be again brought up. I submit, sir, on behalf of the Board of Trade, that we should have had those plans in order that we might give the matter full consideration. I also submit that we have learned to day that while the Commission may have been resting, the promoters have been active; and we further learn—which I think is news to us all—that the promoters have been in communication with the Government engineers. If I read the records of the past at all, it was understood by all parties that the fullest information should be given to them, and that if there were any engineering questions they should have the fullest opportunity of entering into it themselves. I beg respectully, sir, to make my protest. I would say that if there are any—

Chairman GIBBONS: The right to be heard on questions that might be taken up afterwards, is reserved.

Mr. HUTCHESON: May we not deal with the expediency of this question, on the assumption that it is a feasible one? I quite admit that the detail is to a certain degree interwoven with the question of expediency; but if I were conducting a case in court and were given an opportunity of having an engineer examine the ground and test the matter by surveys, levels, measurements, tests of current, velocity, and everything of that sort, not at my own expense but at the expense of the Government, and failed during a period of more than a year to avail myself of that opportunity, I should think I would come to court with a very lame case if I should again ask a postponement for lack of information.

Mr. KING: That was on a different set of plans.

Chairman GIBBONS: At the meeting in Buffalo I raised this question myself, that in the absence of details it was impossible to finally decide this matter. The other members of the Commission thought that as the matter was coming before Congress, and had to be dealt with there on the general principle, all that was asked of the Commission was whether there was any objection to the

Bill in Congress. That Bill only provides for the erection of these dams subject to the approval of the Government of the Dominion of Canada and also subject to the approval of the Secretary of War for the United States. It was urged upon me by my confreres, and I think rightly, that there was no reason why this general question should not be disposed of. The desire was that we should have acted at Buffalo. I object to any action at all until we have had time to hear the general objections to the scheme. Now, the Act introduced into Congress makes special provision that nothing is to be done without the consent of the Dominion of Canada; and the Bill as amended by Congress, if our Commission report at all favourably to the project, will not only make provision that these plans should be approved of by the two Governments, but will make provision also for carrying out the principle which we have enunciated, of protecting Canadian interests, the interests of both countries, with an equal division of this power. We have had to-day general statements; my learned friends have spoken as if they could not give any decision because they did not have information; we have had numerous resolutions passed by people who had reasons we supposed, for passing them, and we had hoped that they would come here and give us those reasons. They did come to conclusions. I certainly did not know that anybody had asked for plans. It is the first I hear of it. I think everybody who attended the meeting in Montreal will agree that I personally made every effort that an engineer should be appointed, and that the strictest inquiry should be made into this matter. There has been no attempt by any member of this Commission to rush things. At the meeting in Buffalo my confrères thought we ought to decide the preliminary matter whether under certain conditions, and only under certain conditions, this work should go on. Now, I think it would be very foolish, having come to this meeting with all these people, if we could not thresh out these generalities now, and I can assure you that you need not be the slightest bit afraid that anybody will consent to go on with this work until the details are fully looked into and the work is approved of, as it must be approved of by the two governments, at Washington and at Ottawa, and possibly also by this Commission if these two Governments refer to us to approve of these details. Now, I think we can go on with our general discussion, and I think you can leave these details to be looked after by those on whom the obligation rests.

F. W. Meredith: Acting for the Shipping Federation of Canada it appears to us that at present we have a certain amount of information about this scheme. We have made up our minds from the information that we have, but we have not got the whole information. Now, I do not think it wise for anybody to be asked to give an opinion unless he has the whole information. You have been good enough to ask different corporations, among them the one for whom I act, to give expression to their feelings. Now, we learn to-day that we have not all the information about this scheme, but that, on the contrary, apparently the only people who have got it are the Government engineers, who are no doubt very capable people. But, it seems to me that in order to understand this thing properly we ought to have it put before us with the same information as the Government engineers have been put in possession of, in order that we may intelligibly give our views on the situation as it is to-day. (Hear hear). It seems to me to be absolutely useless for people to be called here and asked to give their views, and not to be told the whole thing. It is like giving an opinion on a half-stated case and in fact that is what it is; and I submit that those plans that have been submitted to the Government engineers should have been submitted to the parties interested. That was understood a year ago in the King Edward Hotel, and has not been done. What the Shipping Federation are looking for is the whole scheme in order that they may intelligently ascertain from people who understand these matters whether the scheme is on the whole going to be for the benefit of Canada in so far as navigation is concerned; not for any local part, but for the whole of Canada.

Mr. Hilliard: As the position of the province of Ontario takes goes to the root of the whole matter in so far as constitutional questions are concerned, and not on any question of detail, I propose at this stage, if you will permit me, to enunciate—

Chairman Gibbons: No, I dont think I will permit you. I think we will go on in the usual order and hear those still who are in favour of the Bill, and then we will hear the answer. (Hear hear) I have great respect for you, but I think we still desire to hear what those in favor of this Bill have to say, and then hear as fully as you like, from you and other gentlemen who are opposed to it.

Mr. Watson: Perhaps in connection with that you might hear those who are in favour of the proposition.

Senator Derbyshire: I want to know if the Chairman is to be obeyed.

Chairman Gibbons: The Chairman will take care of himself, if you will allow him. Mr. McCarthy, if you will tell the next gentlemen you wish to address the meeting.

Mr. McCarthy: Mr. Plummer.

Mr. King: I hate to repeat myself, but we had some questions we wanted to ask.

Chairman: You should have the privilege of asking as many questions as you please.

Mr. King: How far up the St. Lawrence do you propose to raise the level? You mention two feet and some inches at Lock 21; how much further will the change in the level take place?

Mr. Rickey: What do you mean by the change of level? A millionth an inch, or two inches, or three inches?

Mr. King: An inch or so.

Mr. Rickey: At Bradford's Point, above Farran's Point, roughly about five miles west of Croil island, as the back-water rises, will be approximately six inches at that point, and at Morrisburg it will be a little over an inch, possibly two inches, between one and two inches.

Mr. King: Then you do away with the necessity for the Farran's Point canal?

Mr. Rickey: No, sir.

Mr. King: There will still be some current there?

Mr. Rickey: There will still be some current there, but it will be reduced at the Farran's Point canal.

Mr. King: And navigable by all boats going up and down the St. Lawrence?

Mr Rickey: You mean on the outside channel?

Mr. King: You know only some of our boats can now go up Farran's channel.

Mr. Rickey: It will not be materially reduced; it may be improved. The back-water rise will be only approximately a foot—You will reduce the current about 4%.

Mr. McCarthy: Mr. Plummer.

Mr. PLUMMER: I understand this is to be dealt with just in a general way; and as representing a freight interest I would say that if we have proper assurance that the present channels will not be interfered with; that the proposed lock on the American side will be open seven days in the week, or six days if Sunday is not allowed by law; and that it is free to Canadian boats; then as a freight interest we are in favour absolutely. (Hear, hear) And I speak representing what we call Lake Freight Association, which includes the majority of the package freighters on Canada freight from Montreal to Fort William and return. That is all I can say in a general way. We are distinctly in favour of it if it does as I say.

Mr. MACLAREN: Mr. Chairman, and members of the Waterways Commission : I have the honour to represent, as President, the Brockville Board of Trade, also the Trades and Labour Council, the manufacturing industries and industrial activities of the town of Brockville. I might say at the outset that all those interests in Brockville are a unit unquestionably in favour of this scheme as outlined to-day. We are here to voice our opinions in favour of this plan, and to ask that favourable consideration be given to the granting of this Charter to the Long Sault Development Company. Geographically we are situated on the height of land between Pennsylvania and Nova Scotia. We therefore have to pay the highest freight for our coal. It costs us over $40 per horse-power for ten hours to produce power industrially in that locality. If we get electric power there we hope to be able to reduce that cost to $15 or $18 per horse-power for 24 hours. Now, then, we think that is worthy of considerable attention from an industrial standpoint; therefore we ask that this point be given very favourable consideration. It has been pointed out that electric power is a substitute for coal, and is commonly called 'white coal'; and if that is the case, then we have at our doors at Brockville a great deal of that natural resource of Canada—white coal. Under the arrangement that is being proposed now I presume we can get from there at least 300,000 h.p., and that power to be developed there for Canadian use. The conservation of our natural resources is at present occupying a great deal of the national attention. It is said that coal is one of the greatest of those natural resources; and if by utilizing electric power instead of coal we can save for other parts of Canada where coal is used, and where they have not electric power, then we are going a long way towards conserving one of our great natural resources by using power where power can be used in those localities and parts of Canada where power is, in order to leave the coal in our national deposits for those parts of Canada where electric power is not developed. This plan of the Long Sault Company also conserves the water-power of Canada. It is, as I understand it, on the American side of the international boundary. This power is largely in the United States. Now, if we can by using the other follow's material save our own material, surely we are conserving our own material, in using the other fellow's. Therefore I think that if we use the power of the United States instead of Canadian power, to the extent that we use that American power we are conserving our own power. Therefore we are helping the conservation of our natural resources in water-power by utilizing the power from the United States. This proposition could be illustrated conversely by the pulp industry at Fort Frances. We notice how our Canadian pulp industry is affected there. If one goes to Fort Frances he can see on the opposite side of the line large pulp mills at Minnesota in the United States, developed by United States capital, utilizing United States labour, making profit for the American and drawing their raw materials from Canada. Now, we claim that they are conserving their own national resources of pulp wood, but they are consuming ours. We therefore think conversely, that if we can consume the power from the United States we are, at that point in particular, conserving our own, and leaving all the power to the north of us for that part of eastern Ontario which needs power as badly as we do. Now, coming down more particularly to our own interests industrially, I might say that in Brockville we had a few years ago an American concern come there and start a plant, which they operated for a considerable period of time. There were rumours that they were going to leave Brockville and go to another part of Ontario where power could be had. We offered them $50,000 of a bonus to stay; we offered them free light, free water and exemption from taxes; but these inducements, large as we thought them at the time, were of no consideration to them whatever and they moved to western Ontario where they could get power. Another industry that we had hopes of keeping in Brockville because local capital is largely interested in that concern, left us and took with them fifty of our people to Welland. The other concern that I spoke of took 150 of our people, and at the present time they have in their employ, as I understand it, nearly 3,000 people. All this has been lost to Brockville—these great industrial advantages. At the present time our own factories have promised definitely that if we can get electrical power there they will largely increase their institutions. Therefore we think that these are great and weighty reasons why we in that part of the St. Lawrence and that part of eastern Ontario are deeply interested in this question. This power also, from the larger standpoint, will undoubtedly tend towards the electrofication, as it were, of Canada, and will also add to the general comfort of the public by doing away with a great many of the inconveniences which at the present time are due to using coal. It will also, I think, conserve another of our natural resources in doing away with the sad ravages from fire along the route that those railways, propelled by electric power, will travers. It has been said publicly, and perhaps will be used as an argument by the Richelieu and Ontario Navigation Company or other interests, that the scenery will be affected. Mr. McCarthy has anticipated that. Now, I think we feel keenly the answer he has given to an argument of that kind. We feel that he has fully answered that by showing that the scenery will be improved when those boats go down through the South Sault channel and through that lock and come around there, and travellers can see 3,800 feet of a dam, over which falls 40 feet of water, they will view one of the finest sights in the world. When they come through the largest lift-lock in the world they will also have something to attract travellers to that part of the country, from the tourists' standpoint. These are things that I think should be considered from the tourists' standpoint. There will be a dam larger than the Assouan or the Assiout dam in Egypt, and something that will attract tourists. Navigation has been also referred to. Now, I take it as a fair principle that a river is not fairly navigable unless it is navigable both ways, up and down. At the present time the Long Sault is not navigable both ways. It is only navigable by light boats going down, but not returning. We think the freight question has been pretty well handled. We appreciate the views. We think it has been fairly shown that four and half hours can be saved to these freighters by this plan. That appeals to us from the shipping standpoint. Now then, in conclusion, we are very much interested in this thing. We feel our position in Brockville very keenly in regard to this matter, and I might say that that is why we have appeared here in such a large body representing our town. We might just as well have brought a thousand, for as a whole we are as enthusiastic as we are as a deputation, and we think that anything that should be done to prevent this scheme from going through would be a stop in backward direction. We feel that there would have to be some very weighty reason indeed that would prevent this scheme from receiving favourable consideration at the hands of the Commission. We feel that it would have to be shown to be very perilous indeed to our country as a nation. Now, we take a larger view, as well as a local view, of this question, and we feel that Canada can only be made a nation, industrially and every other way, by having the natural parts of it built up to contribute their shares to the general progress of our great land. Now, if you will give us down the front in eastern Ontario an opportunity to get cheap power such as Toronto and Western Ontario have, from Niagara Falls, and as Montreal has, we will conserve our industrial activities. At present we are starving for want of power, and our industries are handicapped, lagging, going to sleep. We want something of this kind to waken us up so that we can take part in the industrial development of our country; and it is only by developing the water-powers, wherever they lie, that we can contribute to the general welfare of the whole,and that this nation can be built up. I ask you whether it is fair that one boat, taking 3½ minutes of each day, with 250 or 300 passengers on board for summer amusement, for the pleasant pastime of shooting the chutes, should block the whole industrial development of eastern Ontario?

Chairman GIBBONS: I am sure we are all delighted to hear this. We would have been all broken-hearted if this meeting had not gone on.

Mr. STEWART: I am delighted to come on at a stage when this meeting is in such good temper. Mr. Maclaren has set forth our case so very well that it leaves very little for me to say. I appear here to-day on behalf of the Light and Power Department of Brockville. If you look up the records of municipal ownership you will find that we stand well into the front in this direction. We have dealt with our public utilities in a broad public way, and in that spirit we desire to approach this Commission to-day. The importance of power has been realized by us. We have reviewed the situation, and have had the advice of experts, and they tell us that our supply of power must come from the eastern St. Lawrence. There are other sources, but they are not reliable, they are erratic, and we have been referred to the eastern St. Lawrence for our sources of power. The proposition now before you, Sir, will give us the power of which we are so much in need. We also appreciate the singular advantage of the St. Lawrence; it would be strange indeed if, living there, we didn't. We love the sight of the passing ships and the commerce of the river, and we would be the very first to rush to its defence in case of attack; but we submit, after a careful examination of this proposition, after going over the ground, that it will be found that navigation is not injured, but on the contrary that it is helped. Now, we have realized that this power has simply been wasting there, and we believe that the proper way to conserve it is to develop it; and that is what we ask. We have been impatient of the delay. We find in Western Ontario there has been development, and nothing on our part. We are not asking for the pledging of public credit or the spending of public money; we simply ask that the Company that have the money and the faith to do it be permitted to do it, and give us this power. I don't think a better proposition, from a public standpoint, could be submitted to any body of men. Now, we are very much in earnest about this. There are eighteen or twenty of us here representing the business interests of the town, and we are sure that this will receive sympathetic consideration. We say that navigation will be improved; that natural resources will be conserved; and that if this is carried through we will have an example of international harmony and co-operation that will be very acceptable to all concerned.

Mr. HUTCHESON: I am naturally a lazy beggar, and I am glad to realize that much of the work that might have fallen on me has been so well done by those who have spoken before me, and that I may save myself a good deal of labour. I think I can dig up a few things that have not yet been said, or not fully said. One suggestion was made which raised a question in one's mind as to its being a case of eastern Ontario against western Ontario. (Hear, hear). I say they are in partnership. It is not a case of the west robbing the east so much as a case of the east helping the west by development of itself; for if we can develop the industries and make the goods and sell them, we must buy goods, and we will thus increase the traffic, the commerce of the country in every direction, and the whole commonwealth must thrive. (Hear, hear) Then when it comes to a question of consideration of scenic beauties, that is a matter which must not be left out, it is a matter which must be given its proper concern; it is a matter which must be given due weight, but not over due weight. I say that this country, this continent, cannot afford to neglect the development of its natural resources yet. We are a growing country and a growing continent. Our watchword is the future, not dwelling on the glories of the past, not admiration of the natural scenery, but the development of the resources which we have, so that we may grow up to be two of the great nations living in harmony side by side. And if it comes to a question of scenic beauty, Mr. Chairman and gentlemen, let me ask you what appeals most to the hard-headed men who love to take a tour on the money they have earned by their own labour? Don't they like to see an undertaking which has resulted from the harnessing of the natural resources of the world, and which has resulted in the making of money? Don't they like to see how man has triumphed over the powers of nature, and has accomplished a result which may develop the nation? Give the other consideration its due importance, but don't overlook that consideration, because I submit it is a very important matter. Those thrifty millionaires from the United States, when they take their two weeks summer jaunt and pass down the St. Lawrence and see that mighty dam, and see a sheet of water falling over it, and heed and learn what has been accomplished, will in the years to come enjoy that much more than shooting the chutes, as my friend Mr. Maclaren has said. Then as to the question of natural resources, I am a great believer in the conservation of our natural resources; but it is so easy to draw a herring across the scent in a matter of that kind. Natural resources are of no avail, of course, unless developed. Now, when you develop a coal-mine or a gold mine, after you have disembowelled that mine what have you left? A useless hole in the ground. Its contents do not ever become replaced, you have exhausted its utility, and it is done and down and out. After you have stripped the forest of its timbers, many, many years must elapse and perhaps all time must elapse, before you ever have a forest fit to strip again. But here we have a power which merely needs harnessing when it will go on to all eternity, and until we harness it it is running to waste so far as material advantage is concrened. Now, who can suggest that when we form two companies the right to develop and use that power we are giving away any natural resources? Who can suggest that, especially having regard to the fact that it is to be a fair divide as to the power produced, and that each nation will share equally in that? Coming back to our own poor little town of Brockville, on behalf of which I speak to-day, we do really need some help along material lines. We are a population of some 9,000 people. We have a pretty little town and a sporty little town. We will spend all kinds of money up to the limit of what we have to make our town nice to look at and a nice town to visit; but our tax-rate has crept up in the last nine years from 19 to 25 millions. Even the natural increase of population has been denied to us, because young men go where the field is wider and broader, where they can grow up with the growing country and measure up with their surroundings. We cannot keep them or hope to keep them unless we get something which will induce them to remain at home. Now, gentlemen, surely many things will have to be said as against this proposition before they outweigh some things which myself and our other friends have said and I can only hope that the procedure which we follow in the Courts will to some extent be adopted here, and that in so far as new matter may arise from the objectors to the scheme, that some of us at least may have an opportunity to make some brief reply.

Mr. Pringle: It is very good natured of you to listen to me for a few moments I will promise not to detain you many moments coming as I do from the little factory town of Cornwall, representing as I am the Cornwall Board of Trade and the corporation of the Town of Cornwall. It is hardly necessary for me to say to you that we are a unit in favour of some scheme by which the Long Sault rapids may be harnessed and power may be developed. We have been touched a little with the microbe of power. A few years ago, after great opposition a little power was developed, as you will see on that map, at what is known as Sheek's Island dam. Even that little bit of power has been of enormous advantage to our community. Our population has increased; we have factories to-day--cotton-mills, paper mill, and so on—employing some thousands of people. We have reached our limit. We find at our door a power, probably the greatest on the continent of America, awaiting the men who have confidence and capital to tackle the development of that power. I am not going to dilate on that question, because I conceive from your utterances Mr. Chairman, that you are here to-day largely as an advisory body, to deal largely with the general principle as to the feasibility of the development of this power. You are not here to-day to meet the technical objection there in regard to whether this plan is sufficient to protect all interests. I conceive—I may be wrong—that you are dealing broadly with the general principle: Is it feasible to grant or recommend the development of this power? Will the development of this power in any way affect navigation? I am a layman; I am not a mariner, nor am I an engineer; but I have lived on the banks of that river all my life, and it does not take a mariner and it does not take an engineer to say that it is absolutely feasible and that what has been pointed out to-day by the engineer, Mr. Rickey, is absolutely right, and that when that improvement is made the navigation of the St. Lawrence river is improved to an enormous extent. (Hear, hear and applause.) I did not take this position to-day; I took it years ago—that what our Government should have done in order to assist the navigation of the St. Lawrence river—and any one who wishes—can look and find it on record—was to put in on the north side of that river, just below Sheek's Island dam, one large lift-lock by which steamers could have climbed up the river instead of going through four or five locks, so that they could have gone into that one large lock, gone into Sheek's Island dam, and in a matter of three-quarters of an hour passed along the Sault rapids and gone about their business to the west. So it is no new matter with me. I have been convinced for years that that would be a great aid and a great assistance to navigation. I repeat that it is not necessary to be an engineer or a mariner; any man who knows that location cannot come to any other conclusion than that with a development such as that the interests of navigation in this country will be improved. (Hear, hear.) Now let me say a word . I have heard technical objection here and technical objection there in regard to this matter. But even if you gentlemen, after hearing the representation made here, advise on the general principle that this scheme is feasible, if the engineers of the Dominion Government and the engineers of the American Government, with all their expert knowledge and care, come to the conclusion that there is difficulty in the way of navigation, when they get down to the details which must be gone into, surely the Governments are not bound by your report? You are here simply to act in that advisory capacity, and not to spend year in and year out in going into details. I am getting gray hearing about this proposition. We have been looking forward to it for years. As Mr. McCarthy has properly said, it is not our heritage, nor is it the heritage of the United States; it is our joint heritage, and we are proud of that heritage. It has been placed right at our doors in that portion of Ontario and of Northern

New York for a purpose, and I believe the purpose is to give to us that industrial life which will build up eastern Ontario and Northern New York. (Hear, hear.) What do we see to-day at Massena? A little town almost opposite the town of Cornwall, a few years ago a sleepy hollow—nothing doing except the spring water. To-day, with that small amount of power which has been carried from the St. Lawrence across to the Grass river, you see an enormous industry employing hundreds of men, and many of our Canadian people over there in the employment of that company. (Hear, hear.) What did we see in Cornwall? We saw come to our town one of the largest industries that is to-day in the Dominion of Canada, come and look into the matter of our own power. I personally went with the engineer over the whole district, and unfortunately he had to report that the bringing in of an additional quantity of water from Hoople creek into Sheek's Island would be such an enormous expense that they could not consider it; and that company located in another section, and is to-day employing upwards of a thousand people. (Hear, hear.) Again, we saw the Singer Sewing Machine Company come to our town. We could not give them power ready to locate. Subsequently they went to St. Johns, Quebec. Is it any wonder, Mr. Chairman that we as a town come to you and say to you: Have we not had delay enough? Has not this matter been presented to you for the past four years? Are you not now convinced as to the general principle? Are you not now convinced sufficiently to report that you believe the interests of navigation will not be affected, and leave the matter in the hands of our Government? (Hear, hear.) I am willing to submit to the men who are in control in Ottawa, no matter what party they belong to. (Hear, hear.) I believe they are honest men, and will look after and preserve the interests of our Canadian people, just as the American Government will look after and conserve the interests of the American people. Pardon me, Mr. Chairman and gentlemen, for trespassing on your time, but this matter is very much at heart with the people of eastern Ontario.

Mayor EVANSON: (Prescott:) Gentlemen, and members of the Waterways Commission, I do not appear here with any brief, as some of the gentlemen who were opposing the proceedings this afternoon seem to have. I am here as an ordinary citizen, one whom the citizens of the good Town of Prescott saw fit to elect as their Mayor at the recent election. I can tell any of you gentlemen who have not been there that Prescott is blessed with the best shipping advantages of any town in eastern Ontario. (A voice: 'except Brockville.') I bar no town whatever. (Laughter.) I say Prescott is blessed with the best shipping facilities of any town in Eastern Ontario, and I wish to show that its progress is retarded simply from the fact that we lack cheap power. You know as well as I do that any town is counted dead that is not seeking cheap power. That is what Prescott is seeking to-day, and that is the reason the citizens of Prescott asked me to appear here as their representative. Gentlemen, I assure you that if Prescott had the power it would be in a position to obtain if this scheme is carried out, in ten years' time, in place of seeing the small town of some 3,500 inhabitants we have to-day, you will have a city of at least 10,000 inhabitants. I am sure that the inducements of the town of Brockville are all right, but that you will see there a city of 50,000. (Hear, hear.) This is what we lack; we lack power. We have the two greatest railroads on the continent running into that town—the Grand Trunk and the Canadian Pacific. We have practically communication with the Central Vermont and the New York Central on the opposite side of us. We have every boat that passes from the west, from Fort William and Duluth, to Montreal, passing by our doors. Gentlemen, why not place us in the position to ask those empty barges as they are returning west, to call into our port and take on a cargo that we will be able to manufacture in that town if we have this power? (Hear, hear.) I can assure you, gentlemen, that every citizen in the eastern part of the province of Ontario, especially in the counties of Leeds and Grenville, are strongly in favour of the development of power at the Long Sault. (Hear, hear.) The only objection that can arise, as I see, is that of spoiling the scenic beauty. That will be presented to you by the Richelieu and Ontario Navigation Company. Gentlemen, I say that in less than five years the Richelieu and Ontario Navigation Company will be advertising these dams as the greatest attraction that they have between Toronto and Montreal. (Hear, hear.) In place of advertising the Sault Rapids they will advertise those dams as their greatest attraction. Why, to-day the trip from Prescott to Montreal grows monotonous because they have got too many rapids. (Laughter.) It is nothing but a series of rapids. You get so tired of it you would rather travel by rail. Let us cut out one of the rapids, and give us power; that is what the eastern country wants.

Mr. Henry Holgate: About two years ago the St. Lawrence Power Company submitted their proposition to me for inquiry and advice, and I must say that I treated it with a great deal of respect, knowing that we had to deal with the River St. Lawrence, and recognizing that the scheme was one which would be either an injury or a tremendous benefit, owing to the fact that it was not a local scheme. I did not consider it as a local scheme but part of the channel of the St. Lawrence river, which is important to the whole of Canada. I looked into the matter in connection with Mr. Rickey, and I can say that I conscientiously studied it, with the result that I came to a conclusion, after certain modifications which Mr. Rickey adopted, that the scheme as it stands to-day generally is quite practicable. I have taken full opportunity of discussing the general features of the whole scheme with the engineers of the Dominion Government, both individually and together, and the result has been that these gentlemen have come to our views of the matter; that their apparent opposition at the start was from lack of a clear understanding of the conditions, which have been explained to them since, and which have brought them as practically advocates of the scheme instead of opponents. The question is a very important one, and as I said, cannot be considered altogether as a local one. It must be considered in connection with the whole of the St. Lawrence, which is the most important waterway we have in Canada, and I could not bring myself to advocate anything that I thought would be detrimental to that route. I speak as a Canadian, particularly as a Montrealer, and from the engineering point of view I can see nothing but good that could come out of the schemes which may be developed at the Long Sault rapids. I am looking for the time when all the rapids on the St. Lawrence river will be treated in the same way—(Hear, hear)—and when our navigation will be in that river-bed and not through the rapids system. The enlargement of the system is not far from us, and the time is right upon us at present to study the River St. Lawrence, with regard to the extension of such a system as is proposed here over the whole river from Lake Ontario to the Harbour of Montreal. I think my good old friend Mr. John Kennedy, who was for a time Chief Engineer of the Harbour of Montreal, and is now their Consulting Engineer, will agree that with regard to any interference there might be with the harbour of Montreal, it is totally out of the question; and if I might quote some remarks that Mr. Kennedy made a few days ago, if anybody said it were impracticable to do this work on the St. Lawrence river such as is shown, it is because he—that is the person objecting—could not do it. The works are practicable, I am perfectly sure that when Mr. Kennedy has sufficiently studied the situation, he himself will endorse the plan; and any objections that he may have at the present time—I say it with deference to Mr. Kennedy—have been because he has not had sufficient time to look into all the details. Now, I am not bothering myself very much with details at the present moment; I am dealing with the general scheme and I have no hesitation in saying that the general scheme is perfectly feasible. As a Canadian I want to see it adopted, and in the interests of the St. Lawrence channel I hope some day to see a general scheme adopted.

Mr. KELLY, Chief engineer of the Grand Trunk Railway, said: Mr. Chairman and Gentlemen, my connection with this is purely on technical grounds. Though I am Chief Engineer of the Grand Trunk, I appear here in my strictly personal capacity. My entire life has been devoted to engineering work. I have worked in some of the largest rivers in this country. In this connection, and in the development of this project, I went over the entire field with Mr. Rickey from Lock 20 to Lock 21, over Sheek island up past Croil island, down the Long Sault, and down to Cornwall. I have examined not only the map upon the wall but all of Mr. Rickey's profiles, measurements, and the methods of his calculations. I have not attempted to go through the voluminous calculations incident to a study of that character. It would take weeks. It has already been calculated by several specialists, men of international reputation, I have looked at Mr. Rickey's methods of computation, his methods of study, and I must say he has used the most advanced and the most scientific methods that are familiar to us, or known to us to-day. These calculations being checked and borne out by the eminent engineers who have done work, would convince me that his results as shown to me are correct. These results remove from my mind any doubt as to the perfect feasibility of this plan. The locations selected for the dams are solid ledge rock. Their stability is unquestionable. It is a mere question of design of the dam; and when a corporation will put millions into a project, they will certainly not save thousands in the design of a dam of that character. I understand Mr. Kennedy to have said that no man can tell what ice will do in a river like the St. Lawrence. That is true, but under no condition established by these dams can the ice-gorges be worse than they have been in the St. Lawrence at that point. They will, in fact, be better. To establish the dam further down the stream, as was suggested, would place it in a very bad bottom. The history of the Cornwall bridge, known to every gentleman in this room, is sufficient answer to the judgment displayed by the engineers of this company in moving up-stream to where they got solid rock. Some questions that have been brought up are, the results down-stream from the breaking of a dam. If the entire water impounded back of these dams were suddenly transferred to the reach of the river between the foot of the dam and Cornwall, it would raise the water a trifle over twelve feet. If that water were suddenly transferred to the stretch from the foot of the dam to the foot of Lake St. Frances it would raise the water about six and three-eighths inches; and if it were continued from that point to the foot of Lake St. Louis it would raise the water about 3¾ inches. I certainly can see no harm due to the breaking of a dam. But such a situation is absurd; it would not happen; no great dam of that kind would go out all at once. If it went out piecemeal the results of those rises would be distributed piecemeal down the river. As I say, I went into the matter without prejudice. Had I found anything in Mr. Rickey's general plans that I could have condemned, I would have said so. Had I found anything that would have been detrimental to the interests of Montreal I never would have been here. I can see only from this the saving of energy of over half a million horsepower per year to the development of industries on both sides of the St. Lawrence river, and for many miles in either direction. I therefore come before this Board to say that as an engineer I believe the scheme is entirely feasible, that it is entirely safe, and that any small objections that can be raised as to the resulting currents can easily be taken care of by engineers constructions.

Mr. MCCARTHY: About the ice conditions, I suppose there are facilities in existence to-day which will break up ice?

Mr. KELLY: Oh yes.

Mr. McCARTHY: Could they be utilized in that channel, assuming the dams were there?

Mr. KELLY: Yes, safely, where they could not be used in the swift currents of to-day.

Senator DERBYSHIRE: Mr. Chairman, and gentlemen of the Commission, the one thing we need in the town of Brockville, and have needed for years, is cheap power. We have been looking in every direction for this power, and after hearing our engineers' report, and after having had a large number of our citizens visit this locality, we have come to the conclusion that our chief power must come from that locality, and that if we can get this power developed it will be of vast interest to us in the town of Brockville. It will cheapen the cost of power in that locality, and put us in the position to hold the factories we have at the present time, and to get other large factories and concerns there, on account of the situation. As you know, sir, we are in the most beautiful location on the continent to-day, situated at the foot of the Thousand Islands, on the ever-famous St. Lawrence, the most beautiful place in all the world for scenery and for development. Our citizens are all anxious that we should develop, and we can only do so by having cheaper power so as to retain and increase the development of factories in our locality. We want this power on account of its simplicity, on account of its cleanness, on account of its ease of handling in all our factories, small as well as large; and I am sure that it will be for the advantage not only of our country but for the United States as well that this power should be developed there. I cannot see why a little technical objection should be raised by other parts of the country that have cheap power to-day, for fear that we would go in competition with them in our manufactures and in our development, and with the resources that we can so easily gain in our locality. I feel that the Commission would be justified in recommending this scheme as far as they possibly can, because it has been shown by the engineers that it is feasible, and there is no reason in the world why we should not have cheap power in Brockville as long as this is so easily and so handily obtained. We have the capital at the back of this company that is ready to develop it, so that we feel safe in recommending this scheme to the Commission and to the country.

Mr. FOSTER: Mr. Chairman and Gentlemen, before the case is closed before this Commission I desire on behalf of the St. Lawrence Power Company to say one word to the Commission and one word to the gentlemen interested in this project. When I and Mr. McGuigan and Mr. McCarthy were first approached in connection with this matter we were approached as lawyers and as citizens of Canada and asked to join hand in the development of something that was, so far as Canada in concerned, useless at that time. Because we made that association we neither lost nor sank our interest in things that were Canadian; and I want to tell this Commission, and those gentlemen who are opposing us to-day, that we will retain that same interest. We are not prepared, any one of us, or the men associated with us, to remain for one single moment connected with the St. Lawrence Power Company when any engineer, or any man who is in a position to do it, shows us that we are going to do one of the many things that have been charged against this proposition. (Hear, hear). We have been assured, not by ordinary but by most eminent engineers in the United States and Canada—and we have had the best expert advice that money would enable us to get—that none of the difficulties exist that are said to threaten this project. It is because we believe that this petition should be granted that we appear before your Commission to urge it. We are one with the gentlemen here representing the shipping interests in not wanting the shipping interest of Canada or the St. Lawrence river injured; but we do not believe that the development of Canada should be retarded in order that a few tourist tickets may be sold from some point in America to Montreal. We do not believe that this one single rapid, among the many rapids there are in the river, should remain as it is to-day in order that the little business that is represented there might be transacted. So far as the great question of shipping of this country is concerned, we believe we are not going to injure it. If we did not believe that, we would not be here. I say, Mr. Chairman, we believe in the justice of the case that we put before you. We believe that this power can be developed so as to be a blessing not only to the places that have spoken here to-day, not only parts that have been mentioned, but that it can be a blessing to the great city of Montreal. There we have a population increasing by leaps and bounds, with no power except the little power that is developed there to-day, and the power that is brought from Shawinigan, in the hands of a monopoly that are grinding down the people of that great city. A monopoly that can be met by such a development as we propose. Mr. Beck asks what I am going to do? We are going to have opposition to them.

Hon. Mr. Beck: How long?

Mr. Foster: I don't say how long, but we will take good care that the new contract that is made with the city of Montreal is not tied up as some of the province of Ontario is. I say that Montreal is not here as a unit to oppose this plan; Montreal is not a unit against this proposition. A few men interested in the Light, Heat and Power Company, a few men, including lawyers and others, who are interested in the Street Railway Company, a few men that are interested in some of the Shipping companies, think that it is going to injure them; but the great population of the city of Montreal I believe to be in favour of this proposition. I believe that it will benefit Montreal, and because as a citizen of Montreal I believe that, I give that as an additional reason to urge you to grant this petition.

Mr. McCarthy: Mr. Chairman, I do not propose to try your patience any longer. I desire simply to say that I hand you a list of the gentlemen who have come from Brockville, Cornwall and Prescott to be present and advance their views, representing the locality from which they come.

Chairman Gibbons: Then do I understand that there are no other gentlemen to address the meeting in favour of the proposition?

Mr. Calvin: (Kingston) I understand the speakers on that side are finished?

Chairman Gibbons: Yes.

Mr. Calvin: At this stage I would like to say that at the last hearing of this scheme the Calvin Company, through myself, objected to the scheme because it would shut our rafts out of the river. I now want to say that the Development Company have agreed to bear the loss incidental to our barging timber through the canal, and so we withdraw the objection. (Hear, hear and applause).

Chairman Gibbons: Mr. Beck, do you wish to address us?

Hon. Adam Beck: The government has representatives here.

Mr. Hilliard: You prefer going on, Mr. Chairman?

Chairman Gibbons: We will go on till six o'clock or half past six.

Mr. Hilliard: Mr. Chairman and gentlemen of the Waterways Commission, I was very glad to hear the representative of the promoters of this scheme say that they were ready to pay for the power that would be developed there; that they recognized that there was no ownership in the water. I wish to call the Commission's attention to the fact that in reference to Canada the St. Lawrence Company have taken the very opposite course to what the Long Sault Development Company did in the United States. I fancy that if the Long Sault Development Company had proffered their Bill to Congress in the first instance they would have been recognized until they had acquired, by legislation or otherwise, the rights that are recognized to exist in the State of New York. And so they wisely attended upon the Senate and Legislative Assembly of the State of New York and obtained the requisite legislation to give to them the rights and powers possessed by the State of New York, and that was embodied in the Act of the State of New York, it is now known as Chapter 355. By looking over that Act you will find that when the Congress, the national parliament which has the legislative jurisdiction over international waters, that is to say administrative powers, would grant them such and such authority, then the representative body of the State of New York was to convey to them the ownership in the bed of the river, and the ownership, so to speak, in the proprietary right that exist in the State of New York in the waters flowing over their properties. Now, we stand upon the same footing exactly. The highest court in the British Dominions decided in the year 1898—and that decision is reported in the English Reports of Appeal Cases 1898 at page 700—in a submission by the Dominion Government, representing on the one part the Dominion and on the other part the three provinces—the province of Ontario, the province of Quebec, and the province of Nova Scotia.

Chairman Gibbons: I don't want to shut off any discussion, but you surely don't expect this Commission to settle the question of jurisdiction? I am quite familiar with the decision as to proprietary rights: but that is not the point. It is necessary, in dealing with international waters, to have an international commission to deal with the international questions. We are merely an advisory board. We cannot take away your rights if you have them, nor are we a court to establish anybody's rights if they exist; so I think this is hardly the place to thresh that out.

Mr. Hilliard: It seems to me that it is very foolish, so to speak, from a commercial point of view, to ask those rights from a Government that has not those rights to give.

Chairman Gibbons: That is a matter for this company. They may not get any rights; but all the Commission have to do is to see whether there is any reason, from an international standpoint, why those rights should not be given.

Mr. Hilliard: One of the reasons is that the Government of Canada have not the power to grant those rights.

Chairman Gibbons: Well, they will have to take care of that.

Mr. McCarthy: Are you going to get this Commission to hold that? (Laughter).

Mr. Hilliard: We say this, that the proceedings in the United States were proper; they were right; they went to the Government that had the right to give those rights. Now, it is, so to speak, going cart before the horse in Canada. It may be they will never get the rights from the Ontario Government; it may be they will; but what we say, speaking on behalf of the Government is that any power that is developed from the water of the River St. Lawrence belongs as the proprietary rights of the province of Ontario, as was decided in that case. We furthermore say that the ownership in the soil, in the bed of the river, to the international boundary, the title is in the province of Ontario;

that was also decided in that case; and therefore until these questions are settled, it is absolutely useless to go on with this proceeding. Even in that case it was assured that the Parliament of Canada, might, so to speak—

Chairman Gibbons: I must rule you out of order in that discussion. We cannot settle these questions of jurisdiction. There may be a question between the Dominion and the province as to who has these rights. There is a place to settle that; it is not in the Queen's Hotel, but in a court, at Ottawa or somewhere else.

Mr. Hilliard: We simply wish to put protest at this time, and as long as it is recorded we have discharged our duty to the province, and have not allowed this Commission to go on and make reports while we sit back.

Chairnam Gibbons: It is quite right that you should make the protest, but an argument would do no good.

Mr. James White: Secretary Commission of Conservation, Ottawa: I appear here on behalf of the Commission of Conservation, At the last meeting of the Commission a memorandum was prepared and I was instructed to deliver it to this Commission at its meeting here to-day.

It reads as follows :—

THE COMMISSION OF CONSERVATION

Hon. Clifford Sifton, Chairman.

Ottawa, February 7, 1910.

James White, Secretary.

To the Members of the
International Waterways Commission.

Gentlemen:—I have the honour to refer to the communication of your Secretary, under date of Jan. 11, 1910, and to communicate herewith the views of the Executive Committee of the Commission of Conservation in regard to the application of the St. Lawrence Power Company now before you.

This subject has been considered by the Executive Committee consisting of Hon. Senator Edwards, Mr. E. B. Osler, M.P., Dr. Henry S. Beland, M.P., Mr. F. D. Monk, M.P., Dr. J. W. Robertson, Hon. Mr. Haszard, Premier of Prince Edward Island, Mr. J. F. Mackay and myself. The views herein expressed represent the unanimous opinion of the Committee.

The proceeding is understood to relate to the application of the St. Lawrence Power Company, now pending before the Dominion Government, for leave to construct dams across the St. Lawrence river at and near the Long Sault rapids. As part of the proposed works it is intended to erect an extensice power development plant upon Barnhart island (an American island) and upon the United States mainland and a much smaller plant on the Canadian mainland. Examination of these proposals discloses a variety of important considerations.

(1) It is quite possible that serious damage would result from the construction of the works. Engineers have, it is true, given an opinion that there is no probability of such damage. On the other hand, the opinion of the residents along the shore and the most experienced navigators and observers is apparently almost unanimous in holding that the probability of serious damage is very strong. With all respect to the engineers who have given their opinions, it is submitted that the question is not an engineering problem and that no data exist for the formation of a reliable engineering opinion. No engineer can tell

where or how ice will be formed when in our rigorous climate the flow of a mighty river is interfered with. It is a fact that slight interference has in former years caused great damage from floods and ice jams. The possible total stoppage of the flow of the river as a consequence of the works contemplated is a contingency which cannot be said to be impossible or remote. Such a stoppage would cause enormous damage to private property and would imperil the Cornwall canal which is an integral and essential part of the all-Canadian water route from Lake Superior to the sea.

It does not appear necessary to express an opinion as to whether the weight of evidence or probability is in favour of the view expressed by the engineers or that expressed by the residents of the locality who have intimate knowledge of the history of the river for many years past. The fact that there is any—even the slightest—difference of opinion is a sufficient reason for condemning the proposal. No risk whatever should be incurred in a matter of such vital national importance.

(2) The proposed diversion of water by the dam between the Long Sault island and Barnhart island would take from the main navigable channel between Barnhart island and the United States mainland about 50 % of its water. The effect of such a diversion of water from the navigable channel is impossible to estimate. It can, however, be stated with certainty that the navigability of the channel would not be improved by such diversion.

(3) The construction of the dams in question will result in compelling navigation (other than by the Cornwall canal) to follow a new route known as the South Sault channel. Experienced navigators are of the opinion that this route will be much inferior to that now followed.

(4) The time will undoubtedly arrive in the history of Canada when deeper navigation upon the St. Lawrence will require to be provided for by the Canadian Government. Should the works proposed by the St. Lawrence Power Company be constructed, the Government would no longer have a free hand in undertaking such an enterprise.

(5) The vested rights of the company would require to be considered. Should the engineering plans adopted for improving and deepening navigation interfere with or damage the works of the company, which is reasonably certain to be the case, then the Government would be under the necessity of expropriating such works and paying an enormous sum by way of damages. Moreover it is not clear that such expropriation could be had on any terms. The international character of the works might prove an insuperable bar, in which case the Government would be without remedy, and the improvement of navigation could not be effected.

(5a) The proposed scheme of the St. Lawrence Power Company contemplates making use of the Canadian side of the river simply as a convenient landing-place for a dam. A very slight examination of the plans of the company is sufficient to make it clear that only a small portion of the contemplated expenditure will take place in Canada and only a very small proportion of the total power developed will be developed in Canada.

(6) Looking at the whole scheme, it does not appear that any serious attempt can be made to show that Canadian requirements or Canadian interests are an appreciable factor in the plans of the Company. The plans contemplate the absolute monopolization of the whole power available from the rapids with a minimum consideration of Canadian interests.

(7) No market exists at the present time upon the Canadian side for the power proposed to be developed, or any appreciable portion thereof. When any large quantity of power is required in the territory tributary to the proposed works it can be otherwise provided. There is within the radius of economic transmission abundant power available for development in purely Canadian territory without interfering with the St. Lawrence river in any way.

(8) Should the time come when further power is demanded by Canadian interests and the placing of a dam across the St. Lawrence river is determined upon, one half of the power to be generated thereby will belong of right to Canada and should be permanently retained for Canadian use without any exception or qualification.

(9) The suggestion that power can be generated on the American side, or generated on the Canadian side and exported to the United States, and that thereafter when it is required in Canada the Company can be ordered to deprive its United States customers of the power and deliver it in Canada is regarded as being entirely illusory. If the power is used in the United States, industries will be built up and vested interests created thereby which will be impossible to ignore. The attempt to enforce an order for the delivery of power on the Canadian side after it had for years been exported or used in the United States would lead to serious difficulties. The case is not the same as if the Company and its works were wholly within Canada. If the Company desired to avoid or resist such an order no means would exist of enforcing it without resorting to steps which would be a sure road to international complications.

(10) Although not at present required for actual use, the power possibilities of the St. Lawrence at the Long Sault are very great and the time will undoubtedly come when they will be of enormous value. The present proposition contemplates giving away this valuable asset without any substantial consideration to a foreign company for its private financial advantage.

(11) The obvious conclusion from the facts above recited seems to be that the plain duty of Canada is to maintain her rights of ownership and jurisdiction absolutely unimpaired and intrammelled.

There are other considerations to be taken into account besides those of an exclusively material character.

Canada is becoming increasingly known throughout the world as a land of great natural beauty. Its mountain, woodland and river scenery are unrivalled. Among all the beauty spots of the Dominion perhaps the Long Sault and the romantic and exciting passage over its rapids are the most widely known and the most universally admired. Situated upon the greatest system of fresh-water navigation in the world, midway between the Great Lakes and tide-water, the Long Sault is an important feature in the great panorama which for generations has caused the St. Lawrence to be known throughout the world as the embodiment of the highest type of landscape beauty. Only the most urgent and unavoidable necessity could furnish justification for diminishing in any degree the natural attractions of this great river. The destruction of its finest feature without even the semblance of present necessity would seem to be wholly indefinable.

For the above reasons the executive of the Commission of Conservation desires to place on record its unqualified opposition to the proposition which is before you.

I have the honour to be,
Gentlemen,
(Signed) CLIFFORD SIFTON,
Chairman.

Mr. Hutcheson: May I ask if the Conservation Commission took the evidence of witnesses pro and con before producing that?

Mr. Watson: Will the meeting now adjourn till after dinner or till to-morrow morning?

Chairman Gibbons: We want you to suit your convenience. There are a great many gentlemen here, from a good distance. Mr. Lafleur and Mr.

Smith, I think we ought to consult you, and Mr. Meredith. Would you rather meet this evening?

Mr. Smith: I don't think I ought to mention my own convenience at all. I should be pleased to stay over if necessary.

Chairman Gibbons: It seems to me a matter that you have got to take time to thresh out. We certainly want to get all the information we can from all sources. All we are seeking is light, and I certainly don't want the matter hurried.

Hon. Adam Beck: Mr. Chairman and gentlemen of the Commission, considerable stress has been laid upon the fact of the power requirements on the Canadian side in the vicinity of this development. Mr. McCarthy has gone so far afield as to say that the west is robbing the east.

Mr. McCarthy: Oh no.

Hon. Mr. Beck: I beg your pardon, those are your words.

Mr. McCarthy: I don't think so.

Hon. Mr. Beck: Well, I know it.

Mr. McCarthy: I am sure of it. (Laughter.)

Hon. Mr. Beck: Because the great development that is taking place in the west is robbing the east. It may surprise you to know that the development in the west has received considerable thought and anxiety on the part of the Government and the Hydro-Electric Power Commission. The municipalities lying between Cornwall and Brockville, Kingston, Prescott, and so on, down to Port Hope, have made formal application, I think with the exception of Cornwall, to the Commission for the supply of power. They have been offered a supply of power adequate to meet their requirements at a price somewhat lower than that suggested for the power that is to be sold by this Company (Hear, hear.) Sir Wilfrid Laurier, I am informed on good authority has said that the cry for power in this district must be considered, and that is probably one of the reasons why a development of this nature should take place. Now, I take exception to the statement of the gentlemen from Cornwall that the east has not been considered, and to Mr. McCarthy's, owing to the fact that I have a memorandum here of the different municipalities that have applied for power to the Commission; they are:—Napanee, Durham, Cobourg, Oshawa, Port Hope, Bowmanville, Deseronto, Belleville, Kingston, Prescott, Morrisburg, Picton, Cornwall, Brockville. These have applied for power to the Commission; and to confirm my statements, we have submitted prices to these different municipalities based upon $12-power, not $15-power. And for the information of the gentlemen and the Commission I may say that $15-power is of no use whatever to the municipalities other than Cornwall; the cost is too high. We are buying power at Niagara Falls at $9, and if we are assured of $9 power we will be able, as a Commission, as a Government, to transmit that power to all the municipalities, meeting the development from Niagara Falls to Toronto midway, but not $15 power,. However, the contention that the west is being looked after and not the east, is not justifiable, for our work is not confined to the west or the east or the south or the north. It covers the whole province of Ontario. Port Arthur is at the present time under contract with the Commission. I think Ottawa is receiving some benefit because of the work and the undertaking on the part of this Commission; and the eastern district has been fully considered, and we contemplate completing a transmission line that will reach Brockville in the east and Windsor in the west. Therefore your anxiety as a Commission must not be so very strenuous and severe from the feeling that these municipalities have been neglected and that their requirements have not been met. They have all had the price of power submitted, $12 power; $15 power is not of sufficient importance to consider from that standpoint at all. As to rate regulation, we have not found in the Province of Ontario that rate regulation solves the question. We have rate regulation clauses in the contracts existing between those companies at Niagara Falls and the province of Ontario, but they have been ineffective; we get no results whatever.

Chairman GIBBONS: I don't think the regulations that this Commission will suggest can be compared with your Ontario regulations. If this Commission do suggest regulations, I think the Government will have sense enough to provide properly for the regulation of rate. In your case your regulations did not amount to anything.

Hon, Mr. BECK: That is the absolute conclusion of the Commission and that must be carried out in whatever arrangements are made. We found ourselves at a little disadvantage, and do now, at Niagara Falls. Although we are supposed to have an equal division of the power, two-thirds of the power is being shipped to the United States in addition to the full development in the United States, and we hope we won't have a repetition of that.

Mr. McCARTHY: Might I ask Hon. Mr. Beck when and how he offered power for Brockville?

Hon. Mr. BECK: I did not say Brockville. You are not on my list. I say there is a—

Mr. McCARTHY: Whether it is on your list or not, you read Brockville.

Mr. HUTCHESON: As town solicitor for Brockville I wrote two years ago for power to the Hydro-Electric Commission, and to this day I have not received a reply to my letter.

Chairman GIBBONS: That is a controversy between you and the Hydro-Electric Commission, and is not of interest here.

Meeting adjourned at 6 o'clock p.m. until to-morrow, Wednesday, February 9 at 10 o'clock A.M.

APPENDIX B.—Continued.

TORONTO, Wednesday, Feb. 9, 1910.

The Commission met in the Queen's Hotel at 10 o'clock.
Commissioners and other parties present as on yesterday.

Chairman GIBBONS, in opening meeting, said: I think I ought to mention that in the Bill that was introduced into Congress providing for the construction of this dam, a provision was inserted similar to that in other Acts of the United States. This Bill was subject to a general Act to regulate dams across navigable rivers. The provisions are of the most stringent kind, for authority is given to the Secretary of War to deal with interests of navigation at all times. That is to say, all privileges granted are subject to navigation interests, and can be taken away at any time—I think I am not stating the law too strongly—and the Act of Congress brought in has also this provision, that the consent of the proper authorities on behalf of the Dominion Government is to be given to any work that is to be carried on. I certainly think that if anything is done, whatever decision is arrived at here, that it may be taken for granted that the Canadian authorities will not be less astute in protecting the interests of Canada than are the Americans in the provisions which they made in these special Acts. I don't know who is now ready. Mr. Lafleur?

Mr. **King**: I may have something to say specially in behalf of the Dominion Marine Association, but as the Richelieu and Ontario interests are specially represented, as Mr. Calvin has made arrangements which are satisfactory to him, and as several freighters have already expressed their view to a slight extent, there are other interests I would like to be heard, and would therefore ask Mr. A. A. Wright, of the Chicago Steam Navigation Company, to state his views.

Mr. **Wright**: Mr. Chairman, it is with a good deal of diffidence I come before this meeting, for the simple reason that I sat here yesterday very patiently trying to the best of my ability to find out why we are here, and it is not quite clear to me yet. So far as I can learn from Mr. McCarthy's statements, and the so-called explanation by the engineer, Mr. Rickey, I have failed yet to see anything before this meeting which would justify any opinion being expressed by any one in the room, whether on the Commission or off it. In the first place I would like to make clear to you, Mr. Chairman, the reason why the apparently generous offer that was made to the vested interests was not taken advantage of. I was present with other men representing those interests when that proposition was discussed, and we decided, rightly or wrongly, that it was utterly impracticable, and I will give you the reason so that you can see whether we are wrong in our decision or not. As we understood it, the proposition put up to us was to send engineers to look over the ground and see if it were feasible to put a dam and power plant across the St. Lawrence at that location without interfering with navigation; and we were asked to select engineers to express an opinion on that point. Now, the first difficulty that confronted us was: What would we ask an engineer to do? The only thing that had been presented to us was a sketch, which might as well have been made on the sand with a stick, simply showing that they proposed to put a dam here and a dam there, and a power plant here and a power plant there; but there was no statement showing us comparatively what the shore-line and the heights of water would be as to the shore on the two sides, respectively. They did not tell us what the heights of the dams were; what effect it would have on the currents when the discharges were going on over one or all plants; how it would affect the outlet of the Cornwall canal; whether the discharge was running strong at the north power-plant or at the south power-plant, or at the middle power-plant as the case may be; and we were simply confronted with this—that we had to have a choice of sending an engineer to see if he could evolve a plan which we thought would be practicable, which we could criticize, and if we pointed out that his plan was impracticable, and came before the Commission, we would be told: 'Oh, that is not the plan that is being adopted; your arguments don't affect this plan.' It would be simply putting us in that absurd position, as we thought, taking for granted that engineers are competent to say whether those power-plants will interfere with navigation or not. I am quite willing to admit that engineers can sometimes construct bridges that don't fall down, and dams that don't carry away; but sometimes they fail. It is not only in ancient history that we find engineers making bridges that collapse or dams that are carried away; it is of comparatively recent occurence, and sometimes entailing serious loss of life. We have heard a good deal about broad views, and not looking at this matter in a narrow light; and then what did we hear? All the views that were expressed yesterday, as far as I heard, started from Brockville and ended about Cornwall, or in some cases as far as Montreal. Now, if you look at a map of Canada and the United States, it is a long way from Montreal to the Pacific Ocean. The St. Lawrence waterway is without question the great regulator of freight rates from the west to the Atlantic Ocean. We men cannot say what the requirements along the St. Lawrence waterway may be fifty years from to-day. To show you that, I do not need go farther than ten years ago, when none of those freighters who have spoken here were doing business on the St. Lawrence. And by the way, the consent which those freighters made to this improvement going on was only conditional—'if' so-and-so were done, and 'if' the things they were told were done, then they thought if would be a good plan. None of those gentlemen were interested on the St. Lawrence ten years ago. But you gentlemen, as a Commission, are virtually trustees for future generations, and your recommendations to the respective Governments will be binding probably for all time; because, while the United States Congress or the Dominion Government may have provisions inserted in an Act by which they could blow those works out of there if necessary, we all know that lawyers can have things drag along, as is instanced no later than within the last few years with the franchise granted at the American Sault canal, which held up the United States Government and has delayed construction on the lake by the United States for two years, and has only very recently been out of the way, so that the United States Government could proceed with the construction of a new lock at the Soo canal. We have also this that should be perfectly clear, that when we want someone to navigate steamers we don't go to the most competent engineers in the world, or even the most renowned; we take men who are trained in navigating steamers. Now, the only men who are competent to express an opinion as to the effect of these works are pilots who earn their living piloting vessels in the currents of the St. Lawrence river; and I have yet to hear of one of those men who has stated that he believes that these dams or these power-plants will not be injurious to navigation. Mr. Rickey yesterday, in his so-called explanation of the scheme, failed to tell us even the height of the dam which would be constructed. He did not even show on the plan the full length of the Cornwall canal. Personally, I don't know yet exactly how far it is from the head of the Cornwall canal to the foot of it—from anything which was stated here. I believe it is something in the neighbourhood of eleven miles. We don't know what the fall will be from the outside of these power-plants to the foot of the Cornwall canal. We don't know what the speed of the current will be; what the speed will be if they are developing 100,000 h. p. at one of their plants, and what it will be if they are developing 300,000, or the whole 500,000; what the effect will be on a boat if she came along with the north plant shut down, with a discharge current, or with the south plant shut down. All these are things, gentlemen, which I think should have been furnished to the public if this meeting is to be asked to express either approval or disapproval of this scheme. Now, so far as I can see, there seemed to be two sets of plans. There seemed to be this rough, crude sketch which is given to the rest of us, and another set of plans which seems to be before the Commission, on which apparently we are asked to express an opinion without having seen them. Now, I think that is manifestly unfair. It puts us in this position, that we must leave the whole question to the decision of the honourable Commission without being able intelligently to give you any assistance by the expression of opinion from men who are concerned in the interests of navigation. Now, so far as the letters are concerned which were read here yesterday, I must say that they took me by surprise. Those letters seem to have been obtained between the annual meeting of the Dominion Marine Association, held at Ottawa on January 26 and 27, when, amongst others, Mr. King and myself were appointed to appear on this deputation and see what we could learn about the scheme, and see if we could get any information on which to base an opinion. Now, I have too much respect for the opinions of these gentlemen, if they expressed them honestly—that is, finally said that the plans were all right—they could not have expressed them on the information which I have received; but why should they have received some different information or different plans from the rest of the vessel interests of

Canada? That is what I cannot understand. All that I have to say to the Commission further is that I am unalterably opposed to any works put in the St. Lawrence river in the hands of private interests whose only object is the earning of dividends. They can have no direct interest in navigation. It is all very well to say that they will bring industries into that small district surrounding; but that is a very small thing against the whole interests of the west. Now then, just take for granted that permission is given to put those works there, and they are found to be prejudicial to navigation; that inside the next fifty years it is found necessary, in order to control the freight rates for the western citizens of both the United States and Canada, to increase the facilities between Lake Ontario and the Atlantic Ocean for the passage of vessels, and we are met by a vested interest there; what could be the result? We will hear the story of the widow and orphan whose funds are invested there in good faith, that cannot be interfered with; and navigation interests will simply have to put up with the result. Mr. Holgate yesterday expressed the opinion that possibly at some future date all the rapids on the St. Lawrence might be covered with dams, and the stretches in the river between those dams used for the passage of ships, instead of canals. Now, as a man interested in the vessel business I would say that would be an ideal scheme; but supposing that it is brought about, and that this scheme is in operation to flood out all the rapids and get the necessary dead water between the dams, it might tend to lower the head of this particular dam; and then we would be met with the objection: 'Oh, you are taking away our franchise; you are reducing the power which we have spent money to develop.' There are a hundred and one questions like that which might come up, and which we have had no opportunity of considering, because, as far as any information which has been given to me at any of these meetings is concerned, we know absolutely nothing about the height of the banks along the St. Lawrence river between those stretches, or what the proposal in any shape or form is, except the crude sketch which was given here yesterday. That, as I have said, does not cover the whole length of the Cornwall canal even; it does not tell us the height of the dam, or anything in connection with it. I will not take any more of your time, gentlemen, because I think I have said enough to show you that we are in absolutely no position to give any intelligent opinion on the merits of this scheme.

John Kennedy: Gentlemen, I represent the Harbour Commissioners of Montreal on this question, and I am not here in their behalf to oppose the damming of the St. Lawremce as a general proposition. I assume that that can be done wisely and safely in some way, but the plans placed before us do not give information enough to show just whether this plan is the best one or not, except as to the main question. The Harbour Commissioners, as conservators of navigation interests on that part of the St. Lawrence—which really means the whole St. Lawrence trade, the country in general, and that the trade ramifying through all other trades—feel that the proposition is put forward rather in inverted shape. I understand, Mr. Chairman, that the Commission holds that navigation interests are paramount. The Harbour Commissioners think so too, and therefore the proposition should be considered as a navigation proposition primarily, and secondarily as a water power development—incidentally rather than primarily. Now it is put forward as a water-power proposition with a navigation attachment, as we may say—which is the wrong way altogether. The Harbour Commissioners therefore hold that it should be dealt with fundamentally as a navigation question; and looked at it that way, it is felt that the damming of the St. Lawrence at that place must be considered as part of a general scheme of dealing with the navigation of the St. Lawrence and improving navigation of the St. Lawrence on a great scale. It is proposed, and no doubt will be carried out that the Welland canal should be enlarged and bring lake vessels down into Lake Ontario and as far as Prescott. But the increase of navigation trade on the St. Lawrence is too rapid that obviously at no very distant date the St. Lawrence navigation capabilities will have to be increased, and on a great scale also. That will be obtained by canalizing the river; not by making lateral canals, but by canalizing the river as is being done in all large canal schemes at present. For instance, the Georgian bay proposition is the canalizing of the Georgian bay. The improvement of the Ohio, which is a great work, is also a work of that character--damming the river and putting in locks and canalizing the river—a proposition which involves the making of some 14 or 15 dams at an estimated cost of $93,000,000. A considerable part of it is already done. Now, the St. Lawrence would undoubtedly be carried out in that way, and that ought to be considered as a link—and primarily, fundamentally as a link—in that navigation. Now, looked at it that way it will at once be seen that it ought to be a Government work, as all the works for the improvement of navigation on any scale, whether large or small, at least of which I have any knowledge, from the Atlantic to the Pacific, are Government works, whether it be a little bit of a lock on the Beaver, say, or a great lock at the Soo, or anything between. All our canals, all the improvements of navigation waterways everywhere are altogether an exclusively Government work. I know of no place at all where there is anything like a river dammed and locks made which are private property, and the navigation dependent upon the lock being built and maintained by private parties. This case would naturally fall under the general rule, and above all things it must be considered that it is in the great waterways of this northern part of the continent —possibly it may be considered the greatest waterway on the whole continent. And then it has additional importance as being an international waterway. Our neighbours to the south are just as much interested in it as we are, and it would surely be a very awkward matter to have the interests of the two nations with a private Company between— a State of New York Company—I do not at all reflect on the excellent gentlemen who are at present promoting the Company, but we know perfectly well that they may sell out next week, or that the whole thing may go into hands of a tremendous merger of so great dimensions that it would be very difficult to get at it. We know by watching the Court records how exceedingly difficult it is to deal with those tremendous trusts, with all the power of the nation prosecuting—of the American nation, where trusts are larger—and this may be in the same position at any moment. Or there may be some insignificant little company put between the property and the real owners, as in recent examples. Now then, the Harbour Commissioners hold that this should be a Government work if at all, and that it should be carried out in the interests of navigation. They hold also that there ought to be a channel on the boundary line—the boundary channel which is to be enlarged under the scheme, to be a thousand feet in width; and to carry off the St. Lawrence through it, it will have to be some thirty feet deep. That ought to be so laid out and made as to be an international navigable channel, and that at least one lock should be in Canadian waters, or certainly on the line, and not away south, out of the Canadian travel altogether. Of course there is no objection to a lock on that side, certainly not; it would be all the better for navigation interests, because I assume that both nations could use it, as at Sault St. Marie. But surely there ought to be one on the Canadian side; we hold to that; and for the very same reasons that the Canadian Government felt impelled to build a lock on the Canadian side of the Soo, when there were locks already on the American side of the Sault which were perfectly free to us and could be used with every courtesy, and we had just as good rights and just as good treatment as the boats of the American lines; yet the Canadian Government felt impelled to build a lock on its own side, and to dredge approaches at great cost. The same policy should apply, surely, to the St. Lawrence further down, where all the indications are that the trade will be enormous within a very reasonable time. Then as to the water-powers, the Harbour Commissioners are interested in that too, in the sense that any powers there will be to the interest of all the surrounding country—Montreal to the east, and further, and other towns along the St. Lawrence to the west. These will be promoters of trade and of the navigation interests of the whole neighbourhood. The Harbour of Montreal, Montreal City, and through that the nation, are immensely interested in the development of water-powers. They hold that the energy to be developed from half the waters of the St. Lawrence should be developed on the Canadian side, and wholly on the Canadian side; that it is entirely unsafe and unwise to allow that to be taken over out of the country, out of the control of Government, and put on the other side. The province of Ontario has adopted the policy of putting the waters under the Hydro-Electric Commission. Quebec is doing the same. The Dominion Government has appointed a Commission on Conservation of Resources. Now, obviously the resources of the St. Lawrence river are tremendous, and ought to be so treated as to contribute in the very best and highest manner to the prosperity of the country. We hold that it cannot be safely done by allowing that power to be taken to the American side. The plan, so far as it can be understood, provides that a large channel would be made on the north side, and certain powerhouses built upon that; and we are told that only one-fifth of the power is intended to be developed on Canadian soil. Now, the plan, so far as can be judged, and without any very great difficulty, could be just reversed, and the powerhouses put on the Canadian soil on the same channel; and that should be done. Mr. Rickey says that there is not room to put them between that and the Cornwall canal on the Canadian side. I think we have some engineers that could solve that little problem of putting those powerhouses on our own side of the channel without any sort of difficulty at all. (Hear, hear and applause.) There is just no sort of difficulty about that. That is really a peculiar statement to make. So the Commissioners are interested in that way, and they protest decidedly against the taking of the power to the American side. So the Harbour Commissioners desire that the works should be built by Government; that the navigation works should be under absolute Canadian Government control; that there should be a channel and lock on this side under such absolute control—I can hardly say how it could be done, for we have no experience of any hinge of that kind, but the Government has so uniformly kept all such works in its own hands that I cannot see any other course in that respect; then, that the development of half of the St. Lawrence, some 350,000 h.p. should be on our own side. As to the development of the water-power, I imagine it would not be a charitable affair. We are told that the estimate is some $24,000,000. Suppose prices rose and difficulties occurred, and it came to $35,000,000. Ten per cent would pay interest on that and something for water and maintenance; that is only $5 per horse-power for the water. It does not take very much more after that to put in turbines, in a case like that, and distribute the power, so that it does not get anywhere near $15 at all. It is a paying concern. (Laughter). The Government would have its canals and improved navigation, and have something to the good after paying for it, and it would yield a rental to the Ontario Government, and the Ontario Government seems to be entitled to a yield of rental quite as much as they get from Niagara Falls—and by the way, they ought to get more, for it is a small rental there.

Chairman Gibbons: I am sure we are all very much delighted, both sides, to hear from Mr. Kennedy. That is the kind of talk that the Commission would like to hear, getting to practical work. I just want to disabuse the minds of Mr. Kennedy and the others. It has never been proposed that the Commission should now approve of any plans. Those plans are not the subject of approval. What we did think was that we would get suggestions at this meeting, and hear from people like yourself as to whether it was possible to dam the St. Lawrence without injuring the interests of navigation. The scheme, if any is approved would be safe-guarded with respect to nearly all the matters that you have spoken of, undoubtedly, by both Governments before it would be carried out. Certainly there would be no reason why our Government should not build locks, but the lock that is proposed would be handed over immediately and become the property of the American Government; it certainly would not be in private hands. Nobody proposes that a lock on the St. Lawrence should be in the private hands of any corporation.

Mr. KENNEDY: We had to deal with the proposition as it stands. The proposition put before us is that it should not be handed over to the Governments at all.

Chairman GIBBONS: Oh, absolutely. That was always the proposition. It becomes Government property immediately.

Mr. KING: Would the Chairman indicate if he has in his mind what were the proposed safe-guards to be put on the proposition before us, that one-half of the power would remain Canadian?

Chairman GIBBONS: I don't want to get into that general discussion. I am not seeking to avoid it, but I don't think it wise to now discuss it. One of the conditions agreed upon by the Commission is that one-half shall be reserved. I am very glad to hear what Mr. Kennedy has had to say. Certainly if one-half of the power can be developed on the Canadian side, that is the way to do it. I think the Commission will agree upon that. That is a matter that will be dealt with later. The principle has been agreed upon that one-half shall be retained and applied for the benefit of Canada. The most effectual way to do that is to build a power-house on the Canadian side for one-half, undoubtedly, if that can be done. (Hear, hear.) Those are matters of detail. They are not going to be surrendered by anything that is done here now, one way or the other. The first point is, is it possible to dam the St. Lawrence without injuring navigation at this point? We have not got to that suggestion at all. The plans would have to be approved of by the Commission; they would have to be approved of by both Governments; and all the matters that Mr. Kennedy has spoken of will have to be protected. It is not going to be done in a day, or hurriedly, and we are very glad to have Mr. Kennedy's advice in the matter.

Mr. PRINGLE: I understand Mr. Kennedy to say that this river can be dammed wisely and safely. I would like to just know exactly what he means by that because I understand that is really the question for the Commission to consider—whether it can be done wisely and safely—and that is his language on that point.

Mr. KENNEDY: I think it can. The dams proposed are not excessively high. There are other dams higher. They are very long, and taking the scheme as a whole, it is larger than anything that has been done hitherto; but there seems to be nothing in it that is at all impossible. It is on a great scale, and it is one of those things that, when they pass beyond the limits of past experience, are always a bit risky. There is some little danger of forgetting something. We have horrible examples of that already not so far back, of just forgetting something and making some little mistake. Then as to the stability of the dams, why, that can be easily secured. Mention has been made of the possibility of their breaking loose. Well now, they ought to be so designed, and I think they can be so designed, that they cannot break loose all at once. They should not be a mere wall set up, just enough to hold, with stability enough to hold the water, but there ought to be great abundance. We know from recent history—instance San Francisco and Charleston and Kingston, Jamaica, and shocks here—that we are liable to earthquake. Sir William Dawson told us not long ago that we might expect some earthquakes on this continent. Now, I assume that dams can be made with such breadth of base that although it might be somewhat damaged, seriously damaged, put out of business as a dam, that it will not go all in one sweep and allow the water to go down. I do not quite agree with my friend Mr. Kelly that it would go just exactly as he thought it would. He says that assuming the water should be suddenly spread, say from the dam to the lower end of Lake St. Francis, it would be so much thickness but it cannot go that way. If the dam was swept out, it would go down in a great wave. It always does. It goes down in a great wave even on the St. Lawrence. We had a case of the water being dammed up somewhere over twenty feet at Montreal by the ice some few springs ago. It broke suddenly, and there was a great wave swept away down to Sorel, sweeping the ice ahead of it, and it went as a wave, not as a spread-out volume, merely raising the level a little. It would go in great volume, and as a great wave sweeping devastation along the banks. But that could be avoided. I assume that the dams can be quite safely made, and that the scheme can be so made as to be a benefit to navigation. Whether it is done this way or not is another question.

Chairman GIBBONS: Mr. Kennedy, I suppose that necessarily must be left to the engineers of the two Governments. These details would have to be worked out with great care, and we are so advised—that the engineers of both Governments would have to be consulted in the working out of these details; the Commission possibly as well, but certainly the engineers of both countries.

Mr. KENNEDY: Yes, Mr. Chairman, but it seems to me that that is something of such tremendous magnitude, and something so outside ordinary practice, that the character of the scheme is fundamental. It is the essence of the matter, and it ought not to be left until last. There ought to be a well-thoughtout scheme, a well-developed scheme,; and in asking for powers to dam the St. Lawrence they ought to say: 'We want to do thus and so,' and the Government engineers ought to get together and advise, and not that the promoters should say: 'We want to dam the St. Lawrence somehow, and we will do it as we like, and get a charter and hold it up.' We were told yesterday that the first step in this matter is to dam the South channel; then the next step is to make a long dam between Long Sault island and Barnharts; and the third step would be the north shore. I don't quite understand how it would work that way, but that is what we are told, and that the first development would last for a long time, and that the final development on the north shore would be a matter for our grandchildren. (A voice: 'Oh no'.) That is what we were told yesterday, sure. (A voice: 'No sir'.) We were told that yesterday.

Chairman GIBBONS: Please don't interrupt, let Mr. Kennedy get through.

Mr. KENNEDY: Well, now, that charter would be there long before our grandchildren came into existence, and the navigation improvement of the St. Lawrence on a great scale will be in hand, and that company will have a charter and development works. Surely that is not wise. The interests of the country should not be put in that way. It is excellently set forth in the protest of the Conservation Commission yesterday, and I am sure the Harbour Commission will join in that, for it was an excellent synopsis of what may be said against the scheme.

Chairman GIBBONS: The Act is not to incorporate any company to carry out the work in the way that is suggested here. It is merely to authorize them to carry it out in such a way as shall be authorized by the two Governments upon the report of their engineers.

Mr. KING: Is that an Act of Congress?

Chairman GIBBONS: Yes, an Act of Congress.

Mr. PRINGLE: And approved by the Commission?

Chairman GIBBONS: We are going to suggest that that be approved by the Commission. That is not in the Act, which says 'approved with the consent of the proper authorities.' I may just say to Mr. Kennedy also that it is not proposed to authorize in the Act of Congress anything that is to be done for the grandchildren. The proposal in the Act is, 'the actual construction of the works hereby authorized shall be commenced within one year and be completed within fifteen years.'

Mr. KENNEDY: There is nothing of that kind in the Canadian application.

Chairman GIBBONS: Well, there will be.

Mr. KENNEDY: Then, Mr. Chairman, the maintenance of the work is a tremendous matter. You see, these dams have to be kept intact all the time. The water has to be regulated in the right way, and the dams have to be kept intact. It is to go on not for a short time or a generation, but it is supposed to go on for centuries, for ought we know— for an indefinite length of time anyway. Now, the whole navigation of the St. Lawrence, the whole navigation interests of the country and of the two countries would be dependent on the skill and vigilance and good behaviour of that company; and we don't know what that company would do in a short time. I have in mind a water-power affair quite lately where dams were intended to be kept up, and they were not kept up, and there was trouble about them, and lawsuits and arbitrations and all sorts of such things; and any engineer in that sort of practice can tell such cases to mind. We don't know. We are told these are on the ledge-rock, and that is good; but dams do go out. It is not long since a dam right on the solid rock went away in two places, first one and then the other, and did great damage; and in that case the slipping out of a piece of bank on the Cornwall canal was nothing at all to it.

Chairman GIBBONS: Mr. Kennedy, just allow me. These things have to be done all over the continent, and in the United States they have a special Act dealing with just such matters, giving the Secretary of War, who represents navigation, absolute authority to protect the public interest; and I suppose we must assume that the Governments of each country will do their duty. We certainly would recommend that similar powers be given on the Canadian side. It is not being left to the public or to the Harbour Commissioners of Montreal or to anybody else. It must be regulated by the properly constituted authorities who are governing this country; and all those protections will be made. This Commission are not foolish enough to recommend that any private company be permitted to erect dams without proper protection of navigation interests such as are found by experience to be necessary.

Mr. KENNEDY: What I was coming at was that the public bodies will feel a great deal more safe to be in the hands of Government direct. (Applause).

Chairman GIBBONS: I see the point; I agree with you there.

Mr. King: Mr. Chairman and gentlemen of the Commission, if I may be allowed to quote a few words of the Chairman yesterday, it is a very easy thing to give judgment without the facts; and if I may be allowed to turn that, it is a much more difficult thing to attempt to state a case or make an argument without the facts. Now, we came to this meeting, the Dominion Marine Association, representing practically all the vessels between Montreal and Port Arthur on the Canadian side, prepared to discuss certain plans which we thought would be laid before us in the fullest and most absolute detail. I referred to that matter yesterday, and perhaps should not go over it again. That is what we understood as the result of the last meeting of the Commission, and we came here prepared simply to hear that discussion perhaps to go away with that information, and to come back again. The whole scope of the inquiry now has been changed, and perhaps has been more definitely changed—to my mind anyway—by the remarks that were made from the chair within the last few minutes. We are told that the intention to-day is simply to decide one question whether these works are feasible and practicable without interference with navigation interests. Now, we all know—

Chairman Gibbons: Under any plan.

Mr. King: Under any plan. It is a very general question we have today, and my heart has been very much cheered by the suggestion from the chair that possibly these plans, when they are finally put in some definite shape, will be passed upon by the Commission; because possibly at that time the Commission will see fit once more to consult navigation interests. (Hear, hear).

Chairman Gibbons: Certainly, certainly.

Mr. King: And if that is so I need take up very little time.

Chairman Gibbons: You quite understand the situation.

Mr. King: I know we are delighted to have that assurance because it has put us firmly where we wish to be. Just a word before I sit down. There is a divergence of opinion in our association, but that divergence does not necessarily make any difference at all in regard to the general principles upon which we are working. Certain lines interested in the carriage of package freight are, to a certain extent quite properly, in favour of the improvement because they think that it will shorten the time of navigation, this difficult point in the St. Lawrence. (Hear, hear). For instance, the letter of Messrs. J. W. Norcross & Co. is written by a firm which has nothing whatever to do with the navigation of vessels up and down the St. Lawrence. They provide the westbound freight for the vessels mentioned by my friend Mr. McCarthy which navigate the St. Lawrence. But approval of the improvement is all subject to the condition as to how it is to be done and the safe-guards which are to be provided. Possibly we can defer that whole question. We have felt from the beginning that that was the main difficulty. When the proposal was first made that the St. Lawrence should be dammed from bank to bank, the resolutions which we and other bodies sent in speak for themselves. To quote the chairman again, resolutions are not of much avail, and we have dropped the resolution part of it, although I have one in my hand which I must present before I sit down (Laughter). It is not from our association, but was handed to us by a friend who left the room. We followed the plan of resolutions for some time because we feared the whole proposal very much. We were looking for information, and we wanted to delay the whole thing till we knew where we were. The information we have not got yet. We refused the proposal, as Mr. Wright pointed out this morning, that we should entrust our case to engineers—although we would not have to pay the engineers, that was not the question—and run the risk of having them say, 'Oh, that is all right; that won't interfere with navigation interests'; and we would be out of court. What we wanted from the beginning, what we want now, is to know in the fullest detail what is proposed, and be able to take our own engineer and our own navigators and have our own little session and go into it and come back to you with reasonable suggestions from the point of view of navigators as well as from the point of view of engineers without being bound to the whole case. It is not for me, as representing the Marine Association, to protest as a Canadian against handing over to a private corporation of powers and franchises which we believe ought to be saved for the public of Canada and of the United States. That is a question that will be debated, perhaps by other representatives. But as representing marine interests I do feel it my duty to say that we do not think it is right that a development scheme should be put before the Commission for the purpose of developing power, with navigation interests tagged on, to be protected as best may be. We think the development of the navigation interests to be of primary importance, and they ought to be looked upon throughout the whole construction in that way; and that the scheme, if it was for the purpose of improving navigation interests, and incidentally developing power, would be one that we could not possibly question for a moment. We do object because it is an effort to develop power, and incidentally to protect us. We say that the cart is before the horse entirely. Now, the Richelieu and Ontario Company of course have very, very serious objections. I do not propose to go into them, because they will be represented individually. Mr. Calvin's interests have disappeared from the discussion for the time being. As to the freighters, we would consider the suggestions reasonable if all these conditions and qualifications are looked after, but we don't know them at present, and the matter simply stands in that way, and we hope to come back before the Commission at a later date to see the plans. Then as to this resolution I have, I did not intend to throw any doubt upon the propriety of the resolution or the words expressed here, because I agree with it myself personally. Mr. W. F. Nickle, the member for Kingston, was just called away to the House, and had been asked by the Kingston Board of Trade to present this resolution, and asked me to do it for him:—

JAS. RICHARDSON & SONS, Limited,
Grain and Commission Merchants.

KINGSTON, ONT., Feb. 6., 1910.

To whom it may concern:—

Resolved by the Kingston Board of Trade that a dam across the Long Sault would be very detrimental to the navigation of the St. Lawrence river as it is impossible to tell how the currents would be changed by a dam of the nature that it is proposed to erect.

Furthermore, the Board of Trade of this city protests against the water-power now owned by the country, passing over the ownership of private corporations, that these powers should be conserved for the use of the people in the future, that we have no right to give away the heritage of those who will come after us, although at the present monent we have in that vicinity a surplus of power, which does not mean that we will have a surplus of power a few years hence. Besides, if cheap power could be obtained, there is no reason why electricity could not be used for heating, and for smelting, as well as for power propositions.

These things will likely come about, therefore it is to the interest of our country that this power should not be given away to any private corporations, and we protest against same strongly.

(Signed) KINGSTON BOARD OF TRADE.
JAMES RICHARDSON,
President.

CHAIRMAN GIBBONS: I do not want to repeat again, but I want it distinctly understood—Mr. King does understand the situation—that it is not proposed to finally deal at all at present with any particular set of plans or propositions. It is proposed by this Commission that if it is thought feasible, that if it is possible to develop power as well as preserve the interest of navigation, any plan to carry these out should be again submitted to the Commission, and should be subject to the criticism of the public interested, and should further have the approval of the engineers of both Governments. As to the other point that is raised as to whether a private corporation or the public should deal with these matters, that is not a matter that can be dealt with by the Commission. Personally I think these should all belong to the country and should be preserved for them; but that is not the business of this International Commission. We are dealing only with the international question. You can all understand that the American members of this Commission have very little interest on the question as to whether the power can be brought from Niagara to Cornwall or not, and on the other questions that were discussed yesterday in connection with the Hydro-Electric Commission, I think it would be better if we would stick to the broad question, for even if power can be brought from Niagara Falls to Cornwall, that is no reason why the Americans should not deliver power on their side.

GEORGE H. WATSON: K.C.: Mr. Chairman and Gentlemen, I have been requested to appear with some other gentlemen to represent a somewhat different class of interests than those who have already appeared and spoken. I refer to the municipalities which are or will be affected, and which are adjoining and alongside the river, particularly to the municipality or town of Morrisburg and the adjoining municipality of Williamsburg, and other adjoining municipalities having a very considerable frontage on the river.

Mr. McCARTHY: Who are the other municipalities?

Mr. WATSON: Particularly I represent Morrisburg and Williamsburg, Mathilda and Canabruck. Now, Mr. Chairman, it is felt, and very seriously too, by those whom I represent, that this scheme which has been proposed and is under consideration by you is not a feasible one and should not have you approval. The municipalities, as such, are very much interested and seriously affected. These particular localities and sections were perhaps the first in the province, or amongst the first in the province, to be occupied and settled, and then by a class of people whom we will always all of us revere and respect and these are their descendants, having what they think are their vested rights and interests, in property particularly; and it is deemed by them that this scheme or commercial proposal will very seriously interfere with their vested rights in interest in property. A few of the circumstances and conditions make it reasonably manifest I think that they will be interfered with in material respects.

In the first place, a distance of about 15½ miles, that is from Morrisburg to the west end of the Cornwall canal, there is a fall of about ten to 10½ feet. That is sufficient, and no more than sufficient, in the best conditions to maintain the current which will keep open the rivers, the waters. This scheme or proposal is intended, if put into effect, to interfere with that current. Now, it is a further circumstance that in this vicinity there are many narrow points in the river.

I need not mention them particularly because you are all so familiar with them; but they are in this immediate vicinity, the narrowest point in the river being near and a little bit above the town of Morrisburg, perhaps a few miles. Now, it is apparent that this commercial scheme or proposal to dam the waters of this river by the construction of a dam practically from shore to shore of the river, and at a height, it is said, from 45 to 50 feet, will materially obstruct the flow of the river and change the water conditions as they exist in that river. Inevitably the water must be dammed back, and those whom I represent feel that the inevitable effect will be that it will be dammed back necessarily upon their property and their interests adjoining this river. Now, that is the strongest possible reason, I think, and from the widest and broadest aspect of this case, why the project should not be deemed to be a feasible one. If it is going to injure or destroy or interfere with the vested property rights and interests of a large section of this community, then it ought not to be put in force and effect unless for other far-reaching and more important reasons it should prevail. They should not be called upon to sacrifice or to be endangered in their position unless it is a matter of actual necessity—such necessity as it is deemed may not be said at all to arise out of a commercial proposal, that is, a commercial proposal promoted by individuals for profit or gain to themselves. That is the position. Now, have in mind, Mr. Chairman and gentlemen, further if you please, that the town of Morrisburg has its leases from the Government of Canada for the purpose of its own local franchises. It has a right to the exercise of these. Amongst others, its water works, built at considerable expense for a municipality such as that, $55 or $45—no small sum for them; its electric light works—another sum equal to that; and then its electric power, perhaps $100,000, a large expenditure from a municipal standpoint apart from individual or company or partnership interests, and those are very considerable for that place. Now, heretofore, on at least three occasions there has been a flooding of the lands adjoining by reason of the raising of the waters of the river, and serious damage has been suffered on some of these occasions, so that even now as matters stand they are face to face with some dangers. The moment that the proposition is put into effect of constructing and maintaining a dam within a short range of these conditions, to the height of 45 feet, then it is not merely probable but almost certain that sooner or later, and perhaps often, too, they will be flooded and wiped out, and great damage and great loss will ensue. Now, what is to be their indemnity? Why should they be put in that extraordinary position? They are not to be ignored. They stand on the highest ground for consideration by your Commission. Of course it may be conceived that in the case of undertakings by the Government of the United States and by the Government of Canada for national purposes of either country or both, some sacrifices they might be called upon to bear, with sufficient protection and indemnity afforded to them. That, however, is not the present proposition. We are here face to face merely with a commercial scheme or proposal for benefit or for gain, and nothing more and nothing less than that. It is, therefore, sought now not merely to endanger and probably to divert our vested rights and interests of long standing in the country, but in addition its is proposed by this scheme, I think, to vest, not in the Government or Governments but in individuals, the vested rights and property rights and interests in the waters and in the earthen soil of this great international high-way between the two countries. Now, we all recollect that under the terms of the Webster-Ashburton treaty the waters of all those international high-ways are expressly and for all time made and to be maintained free and open for the use of the citizens of both countries. This proposition is a subversion of the most material term and condition of the Webster-Ashburton treaty, because it takes or will take from the rights of the citizens of these countries and will vest property rights and interests, inconsistent with those, in individuals forming and maintaining a commercial corporation. This, Mr. Chairman and gentlemen, is I think a most pertenant and material proposition, going to the feasibility or non-feasibility of the whole scheme. Now, then, if it was proposed to the citizens of Canada, to the Parliament of this country, by gentlemen however high in repute and reputation financially and otherwise, that Parliament and Government should give over its rights and interests and control to a body of Canadian citizens, giving them vested rights and interests in this river and its soil—not merely that, but giving them actual possession and control of those rights and of the waters—it will hardly be that it would be entertained as a serious proposition by our Government or by our Parliament. Now, it may be that the Legislature of the State of New York and the Congress of the United States might regard the matter differently; that they might be disposed even to entertain a similar application to their Legislature and their Congress by Canadian citizens—to give over to a new corporation of individuals, foreigners—let me so speak for the purpose of illustration—the control and the possession of their rights and interests in the river. If they would be very generously disposed they might possibly do so. But with us it is even a more serious proposition, I think, than it would be with them, for the reason that we are now called upon to answer the proposition that those rights should be given over to American citizens, who for the most part are the promoters and petitioners for this enterprise, and whose plant will be, for the most part, on the American side. Their interests will all be pro-American; they would control it absolutely from the American side, even although subject to joint legislation between the two countries for corporate purposes. The capital is intended to come from there; the property and assets are to be distributed there; the power goes there, and will be distributed there through New York State and through adjoining states. In that respect vested rights and interests immediately arise, not only in connection with that and the contracts which would be made by this company—contracts which would lead on probably for a term of years and which they would be under obligation to fulfil, and which the grant by Parliament of the franchise would put the Government under obligation to fulfil. So that the decision carries with it continuous rights which cannot be overborne or broken. Not only that. See another element of understood rights and interests. This company of immense proposed capital necessarily for its operation commences by the issue and flotation of its bonds and securing capital of other residents and citizens. Vested interests occur at every possible point, not merely by arising out of contracts, but arising out of those flotations and investments in the bonds and securities, and in addition arising out of investment for manufacturing purposes. So that once done, once this is granted, it may never be recalled. Once possession is yielded, then possession and control of the waters of this river are forever gone not only from the Canadian Government but from the Government of the United States, and are vested in special corporate interests and in special and individual interest. It seems to me this proposition cannot well be said to be feasible at the suggestion of individuals working for profit and for gain. The answer that was suggested in the first place was the necessity for power, the demand and the supply of power. Mr. Chairman, you and the other gentlemen of the Commission must have been very greatly impressed with the frank statements by Mr. Beck on behalf of the Hydro-Electric Commission, on behalf of himself and the Provincial Government, stating that they were prepared to supply all the requirements and demands of every community in the province. That is far-reaching, and as I submit, from the power standpoint is unanswerable; and it comes from the highest provincial authority on the subject. Then, again, every one must have been very greatly impressed with the forcible and concisely stated views of the Conservation Commission presented through the Chairman, Mr. Sifton. Mr. Chairman and gentlemen, I submit that having regard to those conditions and to these various grounds and reasons, that this commercial proposition as now proposed is not fitting or fair or feasible.

Mr. Lafleur: Mr. Chairman and gentlemen, as I told you yesterday, I appear on behalf of the Montreal Board of Trade, and represent no private interests at all. We are guided simply by a desire to protect the commercial interests of the community, and the moment we are convinced that they are not jeopardized our task will be done. After the repeated assurances that have fallen from your lips to-day that this project, which we regard as unfinished, inchoate at the present moment, will when it has reached a proper degree of perfection be re-submitted to this Commission, and that we shall have an opportunity of discussing it and of ascertaining whether it really meets the requirements of the case, it would be inexpedient for me to address you on what I suppose is the main question to-day, that is, whether this scheme as propounded interferes or is likely to interfere with the navigation of the St. Lawrence river. You must not be surprised or take it amiss that we, uninformed, uninstructed as to what was really intended to be done, should have come here in the position of objecters to the scheme. The burden of proof was surely on those propounding the scheme, to have all the information ready for your Commission, and not only for you, but I submit for the general public whose interests are at stake. It was their duty to have all this material ready for consideration before they asked for the adoption of the scheme. I think you must have been impressed by what Mr. Kennedy said a moment ago—and he is a very high authority on the subject—that although there may be some details which can be attended to at a later stage, some of those details may prove to be fundamental, and it may be that the scheme as ultimately propounded to you, and as expressed in plans and specifications, will present such dangers as might induce you to report unfavourably to the scheme. That is why we desire to reserve what we have to say until a later date, until those on whom is undoubtedly the burden of making their case may be ready with the proper material and information. My learned friend Mr. McCarthy, treated the matter as so clear, so simple, so obvious that nothing was to be said on the other side. Now, what strikes me, Mr. Chairman and gentlemen, is this: if the thing is so simple, if it is so obvious, from the engineering point of view, why all this mystery? Why are the plans which were promised a year ago last November, not forthcoming? What is the meaning of this extraordinary secrecy which is maintained up to the very moment when the scheme is presented for final consideration? That is a thing which reasonably excited our suspicion, and we cannot conceive for a moment that those who are promoting the scheme, should ask you to give your judgment upon the matter until they have afforded not only yourselves but the general public the opportunity of criticizing their scheme. Now, that is all I have to say on that branch of the case at the present moment. I am quite conscious of the fact that you do not care to hear from counsel so much as from experts; and it was because I desired to be able to furnish you with expert testimony that I informed you that under the present circumstances, and with the lack of information which existed, it was impossible for us to offer any assistance to you. The evidence which Mr. Kennedy gave to-day is precisely the kind of evidence which we desire to have to submit for your information. It is that kind of intelligent expert evidence that I think should be weighed carefully by your Commission. It is not an *ex parte* statement of the engineers for the promoters unsupported by any reasoned opinion; because I listened with some surprise to the vague generalities which were enunciated by those for whom I have the highest respect—and I have had them examined as experts, and have had them on my side and against me—but never in my life have I heard such vague generalities as fell from their lips—absolutely nothing that could be examined on. Now, I am further impressed, and my clients instruct me to present to your consideration another view which was enunciated by Mr. Kennedy to-day, and that is, whether in making up your minds whether you shall recommend this scheme to the Government in some form or other you should not consider that the proper development of the St. Lawrence navigation through a system of enlarged canals should not be taken in hand by the Government—(Hear, hear)—rather than to allow power schemes to be first placed so as to obstruct the river and impede the action of the Government in the navigation schemes later on. (Hear, hear.) Now, I understood from a remark made by the Chairman a moment ago that this was beyond the province of this Commission. You have considered it sufficiently within your province to make provisions—

Chairman Gibbons: I did not speak about that; I did not so understand it.

Mr. Lafleur: I am glad if I am mistaken, because it seems to me that this is germane to the object you were going to recommend to the Government, and your recommendation of course will have enormous weight on the technical question. You are going to recommend to the Government that this scheme is feasible or is not feasible, and that it should be carried out on certain lines approved by you. Now, if it be true, as we are told, that the Government has in view the enlargement of the canals on a considerable scale, if it be true, as Mr. Kennedy says, that the proper way is to encourage this enlargement of the canals and the damming of the river for navigation purposes, and incidentally to develop power, it follows as a matter of course that all this work should be under Government control, should be Government work. It is impossible to separate the two questions, and I would ask you to give that matter your most serious consideration in the recommendations which you are about to make. I was very much impressed with what Mr. Kennedy said upon the subject; and it is entirely in accordance with the views which my clients have instructed me to present to you.

Mr. Cumberland: Mr. Chairman, on behalf of the Board of Trade of the city of Toronto we are very glad indeed to follow in the lines of the Board of Trade of Montreal in thinking that every use that is possible should be made in these river lines of communication for the advantage of all the people, and the trade of our two countries. I understood you to say a few minutes ago, sir, that this meeting was not for the purpose of considering any particular plans or propositions, and I also understood that it might be considered within your powers to make some reference upon the general proposition of the possibility of the river being used—I am rather enlarging upon your words— at all events being use for development purposes; it was within your power to advise the Government as to whether it might be done on a government basis.

Chairman Gibbons: Well, hardly; no. I said that was a matter for Government policy, but not for us.

Mr. Cumberland: Well, at all events you asked for information upon the general principle, that you could report upon the general principle without being bound as to whether it should be a development by a company or by a Government. Then I would ask under those circumstances that it would be quite understood that the notices of this meeting should not be considered as binding upon any-one, because the notice of this meeting calls it not for the general purposes but for a particular purpose—for the particular purpose of considering the development of power at the Long Sault rapids by the Long Sault Development Company of New York and the St. Lawrence Power Company of Ontario. I understand, therefore, that that definition of the single purpose of this meeting has to be construed to be that we are discussing the general proposition and the general possibilities, not the particular plans. I am glad of it, because we did not have that before us, and that was one of the main points that the Board of Trade of Toronto raised. I will then proceed to speak upon the subject on general principles, not solely as a member of the Board of Trade, but one as having had rather a long life of association with navigation. I understand the general principle is that the developments are to be subject to the rights of navigation. Tersely, this is a navigable river. It has its whole flow eastward. Its capacity for being used eastwards is admitted; I need not go into details. Westwards there seems to have been an impression that it was of no use and never had been used. On the contrary, the whole of the central sections of the United States and the whole of Upper Canada was at one time dependent upon that river for the interchange of its trade, and the internal trade of the districts on both sides of the lakes above these Long Sault rapids was carried up by bateaux through that river. It was at that time a navigable river, used for navigable purposes, as a means of communication for the trade of the two countries. I hold, therefore, that the rights of navigation are distinct both eastwards and westwards. And if we are going to deal with the future centuries in respect to this river it is not unfair that we should look backwards for 60 or 70 years when this river was used upwards for navigable purposes. I take it, then, sir, that the desire of your Commission is to see how far any division of the flow of water upon this international stream can be made so as to permit of development possibilities on each side of this international river, subject to the interests of navigation. There is no other instance that I know of in which you have dealt at all differently. Take, for instance, at the Sault Ste. Marie. There you have divided the flow of water correctly between the two sides of the channel, subject to the right of navigation. I hold, therefore, that the rights of these two countries to navigation upon that river are inalienable, and can only be dealt with for the purposes of development subject to the rights of navigation. I will come to another point. It divides itself practically into the use of navigation for the two classes—passenger and freight trade. Take it first on passenger and tourist rights in the Long Sault rapids. These are spread far wider than has hitherto been brought before this Commission. These rapids are one of the wonders of the world. The Long Sault rapids are as truly one of the wonders of the world as are the Niagara Falls. There are no rapids in the world like them. There is no rapid in this world where a large-sized steamer can go down their billowing waters, and under careful direction give the people an instance of the mighty power of a mighty river, as is given in the Sault rapids. They are incomparable; they are unequalled. Now, this is one of the marvels of nature. The proposition is that it shall be destroyed; that it shall be absolutely wiped off the face of earth, or of water. I hold, sir, that your Commission is not likely, from your past actions, to recommend such a proposal without very considerable deliberation. What are the rights that you are to consider? They are not the rights of one single company; they are the rights of the travelling public—people that come from other lands as well as this. And I want to submit to you that they are the rights of the City of Toronto, of Buffalo, of Niagara Falls, of every city along the line of the northern tourist route that is interested in the passage and accumulation of passengers and tourist people through their district. There is not any one in Buffalo, Niagara Falls or Toronto who is interested in any way by the incoming and outgoing of any tourist who has not to come under your consideration as having a vested right in these rapids. Now, we have seen what can be done with that business if we look back but a few years when tourists on that route were served very differently from what they are now; when we see the constant increase, the strenuous effort on the part of the navigation companies who are developing that line of tourist travel to keep up with the constant increase of people from all parts of the United States and the world who are seeking the St. Lawrence river. What will it be fifty or a hundred years hence if you are to destroy one of the wonders of nature? Supposing it were said from a commercial point of view: 'There is a great deal of water going to waste over Niagara Falls; it would be much more profitable that we should shut up the Niagara Falls and take all the water and give it into the hands of developing companies on either side.' That would be a practical proposition. You could do it, but you would not. Why? Simply from the interest of the travelling people and our own people who go to see the scenic grandeur which the Almighty gave and which we allow to have kept. I believe, sir, that the Sault rapids stand exactly in the same position as the Niagara Falls. You may take certain portions out of them and develop them, but in the face of public opinion you cannot destroy them. Then as to the subject of Canadian vessels and Canadian trade, I submit that there are larger principles involved than have yet been spoken of. It is proposed that this canal should be entirely upon the American side. I am very glad indeed to hear from Mr. Kennedy that it might also be possible—because engineers, ever since they constructed the Tower of Babel, have come to the conclusion that if you give them money enough—

Chairman GIBBONS: That is not a detail agreed upon at all—that it should be entirely on the American side. There are suggestions that there should be a lock on the Canadian side. I mean that those are details that perhaps we had better not discuss.

Mr. CUMBERLAND: I understood we are discussing the question as to whether it was to be on the American side, and it was said to be on the American side, and the letters that were presented from these various companies deal with it as a lock on the American side, and I claim that that is before this Commission at the present time from those letters that have been already presented. Now I want to give the reason why. Those letters state that an offer has been made to those various transportation and freighting companies, and their approval has been obtained, for a lock to be placed upon the American side. That stands unquestionably before us at this present time. Now, they have been promised full use, and in consideration of being given full use they have modified their acceptance, as Mr. Kennedy has pointed out, with one or two 'ifs' in it. A full use for how long? For to-day or for ever? A promise of full use given by whom? By a private company, and only by a private company.

Chairman GIBBONS: I do not want to interrupt, but any locks will be handed over absolutely to the respective governments, not to be kept in private hands at all. Under no scheme that will be approved by this Commission will any locks be held by anybody privately.

Mr. CUMBERLAND: I am very glad to hear that; but before an absolute consent is given to the movement of the water for that purpose to that side, there is something more required. It is a good thing to say that full use should be given. Now, I hope my American friends upon the Commission will forgive me if I say, as a navigation man, that the offer of the use of the lock is not the dominant question. The ability to use it, the permission to use it, is very much more important. You might offer it, and say, 'You can use it,' but some person also might step in and say, 'You shan't.' Now, may I recall some of the past of navigation —doing it in this way only to say that we have learned to smile at it and to be pleased with it and to forget it, except as a lesson to be learned in any agreements that we may make with respect to the future. In 1870 the only canal was at the Soo. We had a little trouble up in the northwest, when

Lord Wolseley and his men desired to go there. We loaded them on the steamers at Sarnia and Collingwood and took them up to the Soo, and we were not permitted to take them through the canal. Passage through the canal was refused to us, not only to the men, but whatever they wanted to eat or drink or sleep or live with. We had to slip another steamer through the Soo canal up at the upper end of the canal, at a place called Pointe aux Pins, and with that canal lying empty on the American side we had to transfer all our men, our baggage, our munitions, our food, across from Sault Ste. Marie up to Pointe aux Pins and load it on another steamer. It did not last long. What was our answer? We built our own canal; and we have given the use of that canal for ever, without any objection, to our American friends. I will give another instance. In 1872, under the Washington Treaty, it was promised that the canals on both sides were to be used on equal terms by the citizens of both nationalities. Has any Canadian vessel gone down the Erie Canal yet? No; never been allowed to, because the State of New York—this state in which this proposed canal would be—has never given permission to any Canadian vessels to use the New York canal.

Commissioner Clinton: Permit me to interrupt you. There is absolutely no bar to vessels capable of navigating that canal, whether Canadian or American, as they are at liberty to use it all the time without paying toll.

Mr. Cumberland: I hope that when the enlargement of the canal comes, so that the larger vessels can go down, I sincerely trust that our American friends will take a larger view of the proposition.

Commissioner Clinton: I beg your pardon. We never have presented any obstacles whatever to the use of that canal by Canadian vessels. But you speak of vessels; the canal is adapted only to canal barges drawing 7 feet of water.

Mr. Cumberland: Quite true; I knew. Would you allow me to ask whether a Canadian barge can go down the Whitehall Canal in the State of New York?

Commissioner Clinton: That is a proposition with which I am not acquainted.

Mr. Cumberland: The use of the Canadian canals was given; the use of the New York canals was not given. I will give another illustration. Under an arrangement made in 1872 a Canadian barge loading at Ottawa with lumber can proceed to the boundary, but no farther. She must unload there and go back again. She cannot cross the boundary through the Whitehall canal and carry her cargo. An American barge can leave Albany, go up to Ottawa, load with Canadian lumber, go back through the Canadian canal and back through the American canal. We give the American barge the full use of our canals but the State of New York does not give the Canadians the full use of the Whitehall canal. I only mention these as being excellent illustrations. Now, in 1888—I think I am right in the date—Canada was taking tolls upon the Welland canal; the same right of usage, the same rate of toll paid both by Canadian and by American vessels. We conceived it for the interests of our port at Montreal that it might be desirable that when grain was going through in export from Montreal, carried from Lake Erie in an American vessel or in a Canadian vessel, no matter which, that if it was exported from Montreal it should have a rebate of the tolls paid through the canal at Welland. That is a fair proposition. Unfortunately it turned out that it was not so considered by some other people, and the State of Michigan put on a toll on the Sault Ste. Marie canal, and all Canadian vessels, which had previously passed through free and upon exactly the same terms as the American vessels, had to pay tolls during that season. Now, I mention these, sir, only as things which I say are to be taken into consideration before an offer or a promise is given of a free use. They must be settled so that there shall be unquestionably the privilege for all time. In those times I have referred to we were looked upon as back-woods voyageurs, but with the better relations and the greater friendliness that has grown up between Canada and the United States I believe that arrangements could and would be made between the two governments so that a certainty could be arrived at upon the rights of navigation; but not through the medium of a private company. This private company that offers all those rights to these gentlemen who say they accept them, they cannot deliver the goods. They may say 'You may use them,' but they cannot give them the rights of using them, which is the government's only. Therefore, it is a proposition which begins not with private companies, but begins with governments. So much, then, for the freighting. The Commission may say how much water may be diverted for the purpose of these canals, but they cannot in any way give a certainty of the continuation of their use. With respect to the electrical energy, I think we may take it from the proposition that we have seen before us, that the main object is the electrical energy, as Mr. Kennedy very properly put it, and the canal proposition thrown in, that is the real basis of it. And I do not wonder at it when we consider that it has been said by the engineers that 600,000 h. p. can be developed in this proposition. I do not wonder at those who are seeking for such opportunities of development and striving with every endeavour to obtain it. It is a larger proposition than Niagara Falls. I am told that the total output of Niagara Falls is 450,000, which is only a small thing in comparison with the Long Sault. The Niagara Falls is only two-thirds the size of it. No wonder attention is given to it, and no wonder that there is such energy exercised in trying to obtain it.

Chairman GIBBONS: I would just like to ask a question, and get to a point. Do you think that if 600,000 h. p. can be developed without injury to navigation, it ought to be done? Or should it remain idle?

Mr. CUMBERLAND: Are you asking me the question?

Chairman GIBBONS: Yes.

Mr. CUMBERLAND: I say, subject to the rights of navigation you can raise as much as possible—subject to the rights of navigation. I did not say 600,000, but the proposition is that they can maintain 600,000; and this is all on the American side. There is a little bit of it, somewhere about 100,000, on the Canadian side, with another step—to put in a canal and a minor power house. But I am glad indeed to think that there are possibilities of creation of power in that neighbourhood; and those private companies say—and evidently Brockville and Cornwall have been very much affected by it—'We will give you all we want; we will give you all the electrical power that you want.' Can they? They cannot. Who says so? The private company says they will give them. Who says whether they shall or whether they shall not? The Americam Government. And at this present time, as I am advised, there is no power for export. At this present time when those offers are being made to Brockville and Cornwall and other places, and to the country of Canada for the future, there is no power for the export of one single pony-power of electrical energy from the American side to the Canadian; not one. How much is the offer worth? It depends entirely upon the Government; therefore it must begin with the Government. Now, supposing that this whole power was on the Canadian side and we could develop it all on the Canadian side, we cannot get an absolute right of exporting it to the State of New York. To-day the surplus power at Niagara Falls happens to be on our side. What license can you get for export to the United States? For a year? No. For a day? No. All that you can get is a revocable license, subject to be revoked at any time. Now, under those circumstances, seeing that this is the condition of the use of the power developed from this water in the Sault canal, the first point to settle is not, how should it be done? Or, who shall do it? But, what are you going to do with it after you have got it? I think those are prime points in this. Because remember, we are dealing not with to-day; we are dealing with Canada in its future. I submit, therefore, that the proposition or no proposition should be turned the other way round, and the result of the use of the water should first be settled; after that, how it is to be done; and then after that, who is to do it. Now, I want to address my friends from the United States and our people from Canada upon the general subject. I want to speak for a moment or two on behalf, not of navigation, not of any particular interest, but of the whole people of the two countries. I understand that it is the broad proposition that is before us. Now, while a few years ago there might have been some reason—I would not say there is now—for considering a proposition to divide the waterpower with a water company, there is nothing in this proposition that will advance that private company one iota. Why is there such hurry after the matter has been lying still for so long a time? Why do we find these agitations among the municipalities who have been asked to send up their representatives? Why do we find these consultations upon changes of plans being conducted, not with the Commission but outside the Commission? Why is this buying up of opposition, and making arrangements with some of those who were opposed in their trade to this proposition? What is the reason of all this? Because our investing friends have got their ears to the ground, and their eyes to the sky and they see and they hear what is coming. From your western States, from California, right through the whole of that great Republic of yours, from one end of it to the other, your people are to-day agitated behind what they ever were, from Washington outward to the farthest coast, upon the conservation of natural rights of the people. Nothing is there so dominant in the questions which are agitating the United States people at the present time as the preservation of States people, as the preservation of the rights of the land and the water and the powers for the benefit of the people, and to prevent it from passing into the hands of those whom they have designed to speak of as the 'Barons'—the beef barons, the coal barons, the water barons, the electrical barons. I am not using these terms, but the whole agitation in the United States since the time that this proposition was first brought before you, has changed.

Chairman Gibbons: You can call us all 'Barons.'

Mr. Cumberland: It has arisen more, and I want to present to you and to say that your duty, your interests, are the interests of the people at large, not to hand over; it is not to consider whether it is feasible to hand over the natural rights to a private corporation, but to preserve by all means in your power the public right for the people—on our own Canadian side the same question exactly has come up, later than in the United States. I am glad to say that we are following their example in that respect, and conservation is now becoming a dominant question with us and you have the report of the Committee before you. I therefore claim that in taking this matter into consideration you must view it, not from the point of a private proposition, but of taking away a public right—that proposition of stealing the rights of the people, in the promotion of their natural energies must stop and stop now. It will be impossible in the face of public opinion to go on and to propose, by public representatives, to hand over to private individuals the rights which belong to the people at large. The water belongs to the people; the power belongs to the people; and to them only can the rights of it be transferred or be approved of by a commission which represents the people.

Mr. Meredith: I have only a word to say, Mr. Chairman and gentlemen. Anything that I had to say is practically done away with by the fact that you stated, Mr. Chairman, I believe for the Commission, that what you are really going to do now is to decide whether any scheme—not this particular scheme, but any scheme—is feasible. That, I understand, will be reported further with the plans of any scheme, if any scheme is considered feasible—they will come back to you.

Chairman Gibbons: We are going to recommend that they come back. Of course we have no authority to settle that, but that will be the recommendation, I understand, agreed upon by all the Commission—that no scheme should be carried out without being approved by our Commission.

Commissioner Clinton: Practically a condition of the recommendation.

Mr. Meredith: That is what I want to get at, and that when they do come back for your consideration, the parties who believe they are interested in the matter will be given an opportunity of putting before you their views on those plans; that is, I understand, the statement?

Chairman Gibbons: Yes.

Mr. Meredith: The only other view I was asked to put before you for your consideration was this: that if you think any scheme feasible, you should consider the view of the Shipping Federation of Canada, that the scheme should be one that would be constructed and operated by the respective governments who have the rights in the waters and in the river bed; that the giving of these tremendous rights for all time to any individuals, no matter how much respect we may have for them, would be a detriment, and a huge detriment—almost too large to qualify by any adjective—to both countries. That is the view that I have been asked to express; the only one apart from asking for the consideration of plans.

Mr. Smith: K. C.: Mr. Chairman and gentlemen, I suppose I might as well say what I have to say at this period as at any other. When a person comes forward and frankly admits that he represents private interests, he is, so to speak, a marked man; but it may be just as well that you should look at this thing in the concrete, and that you should take into consideration the actual interests that are jeopardized by this scheme. First let me say that the suggestion made at the opening of this discussion that some Montreal attorneys here represented in a concealed fashion the Montreal Light, Heat and Power Company, was one that was purely gratuitous, purely imaginary. Neither my friend Mr. Meredith nor Mr. Lafleur nor myself have any connection whatever with the Light, Heat and Power Company; and the attempt to drug prejudice against that company, 350 miles from home was certainly not creditable to arguments presented in favour of so great a scheme. It is probably an indication of the poverty of argument in favour of it (Laughter.) I wish to answer another thing that has been said, or rather suggested, by a number here—that the people there are starving for power in this immediate locality; starving, dying for power. In their last report the St. Lawrence Company stated that they had 3,000 h. p. undeveloped right there at Cornwall. There is power at Merrickville, there is power at Morrisburg; there is power all over there. And then, in addition to that, we have the authoritative and the official statement of the Honourable Mr. Beck, a member of the Government of the province of Ontario, that they have offered power to all those municipalities; that they are ready to supply power, not at the figure suggested by this company, but at a very much lower rate. So that all this hue and cry, these speeches that have developed a little bluff here in this meeting, are quite aside from the question, because I submit that they have been most emphatically and completely answered by the Honourable Mr. Beck's statement before this Commission.

Chairman GIBBONS: Mr. Smith, will you allow me—because we might as well thrash these things out. Assume there was no immediate demand in Ontario, can an International Commission refuse to permit power to be developed if they want it south of the line because we have no demand here? Just assume that position; I would like you to answer.

Mr. SMITH: I shall be pleased to assume exactly what the Chairman suggests and it opens up a very large question. All these international questions ought to be approached with absolute courtesy; more than that, with delicacy; but as I shall have occasion more than once to refer to these international questions, I say now that I shall make no apology now for doing so, because I have confidence in the men here, who are large men of the world, men of affairs; and there ought to be no mealy-mouthed hesitation of discussing international questions before them; so that I shall adress anything I have to say perhaps more to themselves than to the Canadian members of the International Commission. If you are going to consider, in the recommendation made to Government, the necessities which exist for the power which is proposed to be created, then I say with all possible respect that the Canadian section of the International Waterways Commission ought to consider what are the requirements of Canada in the vicinity.

Chairman GIBBONS: Of course.

Mr. SMITH: What are the requirements for power in the vicinity; and I will not say that it should have a controlling or a determining influence upon their judgment. Far be it from me to dictate in the slightest to you as to your duty. I will not even suggest that it ought to have any controlling effect; but I suggest that it ought to have a very potent influence in determining the recommendation which the Canadian section would make. If it appeared that there was no demand for power whatever, if it appeared that such demand as did exist was already fully supplied with waste power, undeveloped power, right on the spot, then I say that would be at least a proper subject for the International Waterways Commission to take into consideration. Now, let me come to say briefly what I have to say on behalf of the Richelieu and Ontario Navigation Company. If I had had any notes at all, I would feel like suggesting that Mr. Cumberland had stolen those notes from me because he has presented and has elaborated the case for the Richelieu and Ontario Navigation Company much more cogently and gracefully than I could pretend to do. The Long Sault rapids have been navigated since 1843.The Richelieu and Ontario Navigation Company has grown from small beginnings to be very much the largest and most influential of the inland navigation companies, with a capital of five million dollars and a fleet or fleets of vessels that are certainly no discredit to this country. The service has been largely improved. The accommodation has been increased, the company has spent enormous sums of money all over this continent and elsewhere, even in Europe, in advertising this St. Lawrence route. Now, it is all very well to brush this all aside and say, we must not allow shooting the chutes to interfere with industrial development. I suppose, sir, that we must be content to have a car of juggernaut break down all that is beautiful and all that is enjoyable in life at any time. I suppose all our beautiful waterfalls are going to be converted into horse power, and all the picturesque and all the beautiful is to be ignored. But I am not going to put it upon that æsthetic footing at all; I am going to look at it from another point of view. We find by the most carefully compiled statistics than can be obtained that this trade which has gradually been built up by the Richelieu and Ontario Navigation Company brings over 50,000 people to this country every year, and that those people have left from $2,750,000 to $3,000,000 every year among our trades people. They spend $3,000,000 in our country every time they come here. Now, I say that this is worth something. You have stated over and over again that the Board has unanimously sanctioned the principle that navigation interests are to be paramount. Now, the whole thing can be stated in one word: we have now a natural channel; they ask you to substitute an artificial channel. They try to convince you that that is not going to be any impediment to navigation, but in the very next breath my learned friend Mr. McCarthy, with his well known eloquence, told you; 'This is going to be the biggest lift lock in the world; they are going to bring people from all over the continent to see this mighty lift lock that is higher than anything that has ever been constructed.' They are going to dam the whole of the St. Lawrence river and they are going to make us pass through the highest lock that has ever been constructed, and they want you to say it is not an interference with navigation. Let me refer incidentally to another matter. Mr. Calvin here yesterday stated with great clearness and great frankness, which I admired, that he had been, so to speak, disinterested; that he, representing the rafting interests—may I use a vulgar word—had been 'squared'

Mr. McCarthy: The timber, you are speaking of.

Mr. Smith: Not square timber at all events, Mr. Calvin came forward and told you—

Chairman Gibbons: It is a question of deals.

Mr. Smith: Well, I am not going to suggest log-rolling—but at all events Mr. Calvin declared to you here that he had made a contract, and the ink was not quite dry upon the paper, by which this commercial corporation agreed to indemnify him for all his losses. Now, I would like to say this, or ask this: Did they at the same time—

Chairman Gibbons: Fix you?

Mr. Smith: That, I believe, is one of the very best questions that I have heard the Chairman ask to-day? I was not going to put it in that shape, that they fixed me, but what I was going to say was this: Did they make any provision for indemnifying all the other shipping interests that will be affected when Mr. Calvin's logs and Mr. Calvin's rafts and every other rafts are forced through that lock? They don't say to Mr. Calvin: 'You go out of the business'. There is going to be some lumbering done still; there are going to be some rafts going down, and Mr. Calvin's rafts and every body else's rafts are going to come through this single lock that is the biggest lift-lock in the world, and when my steamer comes along and Mr. Calvin's rafts or any other rafts are in the locks, I am going to be detained, the Lord only knows how long. Is there any provision made for compensating those interests? Not at all. I say that the fact that they have agreed to indemnify Mr. Calvin is an admission before this board that they ought, if they get permission, to indemnify all the other interests that they have injured.

Mr. McCarthy: You called that 'square' before?

Mr. Smith: Well, that they should square other interests. It is an admission on their part that they ought to do it, but I say that by doing it in that shape, and by squaring Mr. Calvin, they don't make that transportation route more convenient or any more speedy or expeditious for me or for anybody else using it. Now, there is another matter. That route which we have enjoyed, and which was a free, unobstructed route, passed through international waters. A short portion of it in the bend was wholly within the United States territory, but through international waters it passes unobstructed. It is proposed now to substitute for that unimpeded natural route a single lock which is situated wholly in American territory. Not only is that lock situated wholly in American territory and to be owned, we are told, by the Government of the United States, but all the regulating and controlling works in connection with this power development are to be situated wholly in the United States.

Chairman GIBBONS: May I just interrupt there again? Those details have not been settled, and I do not know that I ought to say so, but I do know that the engineers of the Government of Canada are insisting that a lock should be on the Canadian side. That is one of the details to be discussed subsequently, but the Canadian Government's position so far with regard to that, as I understand it, is that there must be a lock on the Canadian side in the place as well.

Mr. SMITH: I am very much obliged to the Chairman. That illustrates what people have said, and by no one more forcibly said than this morning by Mr. Wright, that we are in the dark.

Chairman GIBBONS: We are not dealing with those details now.

Mr. SMITH: I am speaking of the general outline of the plan that Mr. Rickey gave us on the map yesterday.

Chairman GIBBONS: There is nothing in the form; only the general question is before us that you are discussing--that under no condition should it be dammed. I think what you have said so far in discussion is important.

Mr. SMITH: I was just wondering, if nothing at all has been decided, what was the basis of settlement with Mr. Calvin.

Chairman GIBBONS: I cannot enlighten you as to that.

Mr. SMITH: There seems to have been something definite enough to make a contract in black and white with Mr. Calvin. Well, now, I submit this to you, that we have an actual and existing interest in objecting to the controlling works and the canal or the lock being situated wholly outside of Canadian territory. Those controlling works—I need not emphasize this, for it is apparent to you all—are not part of a navigation proposition, they are part of a power proposition. Those controlling works will be operated in the interests of the power scheme and not in the interests of the navigation scheme. Those controlling works might be so worked as to materially affect the whole channel down to Quebec, and the depth of the channel down to Quebec. Those controlling works would probably come into play more during the low water than at any other time, and if they are held back for power purposes, they might very well affect the channel some inches, which might result very seriously indeed to the whole navigation at the Sault. Now, I say that emphasizes the fact that we have an actual and an existing interest in whatever controlling or regulating devices are adopted, in whatever plan is adopted, in having them situated where they are under the control of our own jurisdiction. I would not suggest that that canal would be used by the United States Government prejudicially to Canadian interests. There have been a number of examples shown by Mr. Cumberland where the Canadians did not feel quite satisfied with their treatment; what I say is that when you are coming now in an international body to discuss a thing, I want our American friends to put themselves exactly in our position, and to look at it as though they were Canadians, not Americans, for the time being. As a judicial body, I ask our American friends to look at this question just as they would look at it as if they were Canadians, and not as Americans.

Chairman GIBBONS: They will, and always have, I am very glad to say.

Mr. SMITH: Then I am sure if they do, they will feel that if a power development of 600,000 h.p. was proposed, and only 100,000 of it could possibly be developed on the American side or within American jurisdiction, and that the lock which was substituted for the free, unimpeded channel of the river was to be situated in Canada, and was to be made over to the Canadian Government, and if all the regulating and controlling works and devices were to be situated wholly in Canada, then I say that I believe in my conscience they would not see fit to make the recommendation. With regard to the scenic effect of the rapids, that was very happily expressed by Mr. Cumberland. That you must look upon as an asset, and as a vested right, seeing so much money has been spent in developing that particular trade. My friends over here argued that you were going to give something better. They were evidently like the Scotch lady who said: 'The works of the Lord are great, but the works of men surpass them all." (Laughter). They are going to substitute this lock and this fill dam as something very picturesque and beautiful, and going to attract the people from all over the world. I think the Richelieu Company that has built up this trade is probably in as good a position as they are, or anybody else, to say what the people come to see. They come to see the greatest chain of rapids and the greatest rapids that are navigable in the whole world, and when once you dam that river of course you will never have it again in the same position; you are doing it once for all. Navigation will never be the same on that river, and it can never be the same on that river, after you once dam it. Now, I am going to be told—I was told by anticipation—that they are going to improve navigation. I cannot discuss this, for the same reason that you have already told me, that there are no plans chosen and nothing adopted, so that I can't tell—I couldn't tell anyway—but I can't be instructed by engineers as to what the current would be. There is a pilot here who has had very many years experience on that river, Captain Batten. I have had conversation with him, and he expresses the greatest doubt and fear concerning the effect upon the currents that those dams will make. How high the dams are, we don't know. Exactly what the deflection of the water is, we don't know. Of course, the 'pilots cannot tell until the currents would be figured' out by engineers; but there is the fact of the matter—that you are not proposing to change the character of the navigation of that river altogether. Now, it is said that that should be done by Government. I must admit that we would not be very much pleased with the Government if they were to dam it; but we are not exactly in the same position if the Government should undertake it, for this reason, that if this private corporation does it, it does it in the interest of power development for dividend purposes. If the Government does it, the Government will do it primarily to take care of navigation. Why, sir, there is in this room at this moment one of the Harbour Commissioners of Montreal, and I have heard him say not three weeks ago that there is a continual race between the production of the west and the transportation facilities of the east. We have developed only 5%, or not 5%, of the arable lands of our Northwest, less than 5% of the millions of acres there that are going to be producing have been scratched by the plough. Year by year you are going to have a stupendous increase in the product of that Northwest that must reach the sea; and the one great artery, the one great channel that must take care of the greater part of all that grain and that produce of the Northwest is the St. Lawrence river—the St. Lawrence river route improved as Mr. Kennedy has suggested, or in some other way improved. I say that the great paramount question before the Government of this country to-day is the question of transportation. I say that general consideration alone should make this Board hesitate to formulate any recommendation that will dam the whole of the River St. Lawrence, which is to be the great outlet for all this product of the Northwest. My friend says he concedes that navigation interests are paramount, and yet he proposes to dam the whole river and to put the trade coming eastward that now uses the rapids in the hands of a foreign though very friendly power, by means of a single lock with regulating devices entirely controlled on that side. He argued very eloquently indeed that he believed in the conservation of our natural resources, but he said conservation means utilization, and the only way that you can conserve our natural resources is by using them. I ask him whether he seriously intended to say to this intelligent Board and this company of people that the way to conserve our national resources is to utilize them, not by the State, but by handing them over to a private corporation to be used for the purpose of making millions of dollars in dividends? I say, sir, that is not the conservation of natural resources, and I say we have a distinct interest in the Government doing this, for the reason that when the Government does it navigation will be made foremost and power development will be incidental fashion, whereas the whole scheme is a scheme of private enterprise—laudable enough—to make private dividends out of our natural and national heritage.

Mr. Hilliard: I spoke yesterday in reference to the legal position of the Ontario Government. I wish to speak to-day of the feasibility of the damming of the Long Sault, and particularly in reference to the vested rights of the inhabitants of the county of Dundas and the village of Morrisburg, a constituency represented by Sir James Whitney himself. The experience of the inhabitants of that locality, coupled with the experience with the navigators of that locality, should have weight, we think, with this Commission. It has been proven by actual test that when there has been a jam at Cornwall below the Long Sault, causing the river to rise twenty feet there, it has caused the river, open all the way, to rise twenty-one inches at the docks at Morrisburg. Speaking generally, that seems an utter impossibility, because of the great height of the Long Sault rapids. We are in a position to bring the witnesses to give that evidence under oath. We have not brought them here to-day because we were not sure of the mode in which that evidence would be received. Moreover, on three different occasions ice bridges formed between Croil's island and the main shore, immediately east of the Farran's Point Canal. These bridges are formed by the islanders at night sawing the ice that forms in the bays during the early season in the still water caused by the eddies at the low island at the east on both sides of Croil's island, making simply a dam two feet thick on either side of those islands. Between that point and the western point of Galops rapids, some thirty-five miles, the river is entirely open, and forms in large quantities anchor ice, frazil ice and slush and snow that blow off the large tracts of the ice of the bays in the shore into the river. Any one standing on the shore along the county of Dundas will see this ice and slush and snow floating down the river in immense quantities. These quantities, caught on the ice bridges, formed at Croil's island in 1879, 1887 and 1905. They backed up at the rate from a half-mile to two miles a day. No appreciable damage is sustained until this slush and cakes of ice and anchor ice that form at the bottom become wedged in back to the narrow parts in the river. One of those places is known as Weaver's Point, about five miles above Croil's island. At that point the ice and the snow, which cement the cakes of ice coming down and catching on, jammed in the bottom. The ice then formed west of that and caused the water to rise above the layer below. In this night time a remarkable shove of ice occurred, shoving up upon the shore lying between Weaver's Point and Cook's bay, crushing down a dwelling house, overturning the stove, and setting the thing on fire. And the people escaped with their lives. Another shove occurred at the same time in daylight, when a lady was driving along the road, drowning her horse, and she escaped, as we say, just by the skin of her teeth; she just barely escaped. In 1905 the whole channel of river west of the village of Morrisburg was filled full of this anchor ice and snow caused by this small dam, so to speak, at Croil's island. It completely submerged the water-powers that we rent from the

Dominion Government. The powers were put out of existence for the time being, and the whole docks, the canal gates, and the canal bank were threatened with this ice. We have here a photograph of the condition of the river, showing the ice blockade (Handing photograph to Chairman). This took place late in the month of February, when the sun had become powerful, and fortunately we had mild weather for the time being, and it began to wear away and wore a current. This is a photograph of the same work with a view of the American shore and the islands; Dry island, which is now owned by Mr. Corrigan, of Cleveland, was absolutely submerged. (Handing second photograph to Chairman). We see the trees. Now, if at that particular time we had had zero weather—which we often have in February—and southwest wind, this would have completely swept the lock gates and would have inundated the greater portion of the village at Morrisburg. We have certain other photographs here, which show the banks of the river at Morrisburg completely inundated. It shows our power house situated on the canal bank, with the water within a very short distance of the over-flow in the canal. We had our steam auxiliary. The water rose in and put the fires out in our steam auxiliary. We had to get a temporary engine put up upon the canal bank to keep our pumping apparatus in condition. These are the other places, showing all the boat houses and wharves completely submerged and under water. Now, what we say is this, that during the history of Canada, and during the period that has been handed down to us by the U. E. Loyalists that settled along this country, there has never been a gorge in the river when it was left to nature. If the islanders, desiring a bridge to drive over in the winter, had not swung these bridges, we would never have had this ice jam. Now, the pertinent part is this, that as Mr. Rickey and Mr. Holgate say, the waters west of the Long Sault are still of two miles an hour, but ice will cake early in December in this northern and rigorous climate. When the days are short, and dark and the accumulations coming down from the Galops rapids and those other rapids are formed, this anchor ice and frazil ice and this slush and snow which blows off the base, we will be having this carried yearly instead of having it three times in our history. But they say: 'Oh, we will take care of that.' We would like to know who the 'we' are, and we would like to know what are the facilities for taking care of us in that way. I dont agree with my learned friends who say they are satisfied with the ruling of the chair to-day that the matter of detail will not be gone into, but that there will be a report as to the feasibility. Now, see. With all due respect, their report on the feasibility only carries weight when the question comes up as to how these other interests are conserved or will be taken care of. The whole feasibility of damming this is to take care of the vested rights along the river bank, and of the villages such as Farran's Point, Osnabruck, Morrisburg, etc., that have been there first and that have their rights. They say they will have ice-breakers. There would be a long strip. You build a dam 40 to 45 feet high at the Long Sault, and you have, so to speak, dead water back to Farran's Point, a distance of 5 or 6 miles. They tell you that it will raise the water 2 inches at Morrisburg. How do they know? There is not a man upon the top of this green earth, or any engineer—and all due respect to the engineers—will know how much in a tortuous river filled with islands, with different currents, how that will affect the people of Morrisburg, with a dam that high, and with water that will be slow to two miles an hour—these are the words of Mr. Holgate, and I bow in respect to him. Now, if that ice is allowed to form we will be blotted out. I have seen these shoves take place. I have seen them to such an extent that large trees on the banks of the river, hard maple, two feet thick, were cut off like pipe-stems. I have seen these great telephone poles, over two feet in thickness at the stem, just shoved off like pipe-stems. I have seen the inhabitants of the county of Dundas remove all the implements, all their carriages, everything that could be moved, that would not freeze up upon the high land close to the Grand Trunk railway, which is practically the height of land, and I have known them to keep watch by night fearing that these shoves would flood them out at night time. Now, I say this is one of the tremendous effects that would be likely to result from the damming of this river there. Gentlemen of this Commission, look at one patent fact. In a distance of fifty miles, from Prescott to Cornwall say, the river drops ninety feet. West of Prescott, it freezes solid. There is no danger of anchor ice west of Prescott. There is no danger of any gorge west of Prescott. There is danger of gorge at Cornwall and east, but so to speak, nature provided for that. There is the Lake St. Francis with its broad rims and greater depth that almost every winter takes care of this anchor ice that is formed in this running water and in those stretches to the west. Now, I can easily conceive if the Long Sault dam, the proposed dam, made a complete bond so that it would be frozen over entirely to Prescott. To that we would not have any particular objection, because while it would block out our power there we might get compensation for our power in the shape of other power, or in the shape of being bought out; but when it only dams back and gives us still water to Farran's Point and there freezes, we are in jeopardy from that point, a distance of 35 miles, with a fall of 33 feet which will not be overcome by this dam. But this being slow to two miles an hour, any mortal man, any child that knows the records of this northern climate, will understand that that will freeze over. But they say: 'We will have an ice-breaker there.' Again, who are the 'we'? The feasibility of this scheme depends entirely on the 'we.' If it is the Dominion Government, we can look to the Dominion Government that it will protect us, but is this Commission going to place the inhabitants all along that river, and the inhabitants of New York State, west of the high lands—because they have higher banks than we have—west of three miles below Waddington, are they going to place the same people in this same condition, with this difference, that the heavy current is toward the Canadian shore, the great trend of the river when this anchor ice is toward the Canadian and not the American shore. I say that before this scheme is reported upon this Commission should not make any interim report, so to speak, and ask for permission to go into the details. This Commission was right when at the King Edward Hotel it asked that the fullest disclosure should be made; and on behalf of the Ontario Government I view with serious alarm that—and I speak it with all due respect that this change of front, so to speak, let us look at it practically. What will be the result? If this Commission reports on the bald question that it is feasible somehow and somewhere and someway, what is the result? That report will go to Congress and this Bill will go through. That report will go to Ottawa, and their Bill will go through. We cannot dissociate this question from the complications that are opening before the Parliaments. It is unalterably mixed up. It is, so to speak, body and bones intertwined and intwined with this development company, and therefore I say that no report should come from this Commission to either Government until the full details were here, and the whole report was passed upon. Because just as sure as we are standing and sitting here, if a report of any kind of feasibility goes to those gouvernments what objection can be based upon the granting of the Acts of Parliament that, so to speak, all safeguards may be looked after otherwise? I fancy my learned friend and the promoters of this scheme would throw up their hats if they could obtain any expression, so to speak, from this Waterways Commission that it is feasible. I come back again with the word 'feasible' meaning practicable feasibility, a feasibility that will safeguard all the interests; and until these speakers shall put before us the provisions made to take care of the people that are liable to suffer damage in these matters, then no Commission can intelligently report on the feasibility of the scheme to dam the St. Lawrence. If I understand the Commission right, on the adjournment or the closing of whatever is said here to-day, they propose to make a report to their various Governments on the feasibility, and then ask that before the plan—the plan, so to speak, by the incorporated company— is assured, that we can have a chance to report on those plans. Gentlemen of the Commission, the damage will then be done. If this Commission first asks the various Governments to allow them to pass upon the plans before they recommend the feasibility of the scheme, then we will all retire. I think I can say we will all retire. (Hear, hear.) But if there is a report made before the plans are submitted, then the damage will be done so far as the different countries are concerned. If I understand right—and I think my learned friends also understood when they said they were satisfied with that—that the Commission would ask for power to report upon the plans before any report was made to the various Governments, if that is the position—and I would wait for an answer to that question, if the Chairman would let me understand that—and I would not talk any more if the Chairman would let me understand.

Chairman Gibbons: I would try to let you understand but I cannot speak for the whole Commission, I have told you what my own view of the matter was. All those matters which you are talking about now have been looked into by Government engineers. I have had the benefit of their special information. This Commission is not learning all about this ice for the first time. All these matters have been reported upon and have been considered by people who think they understand, and are being considered now by the Commission. Now, my own idea was that we shall have cleared the deck by this discussion. It is impossible to thresh out in a meeting like this the details of a scheme of this kind. It never will be possible. The plans will have to be worked out very carefully, and a lot of provisions made that have not been even suggested here, but have suggested themselves to the engineers of the Government and to the Commission. When these things are in shape to submit, my own idea—and I can only speak for myself here—is that the general public ought to be again taken into our confidence. If we agree at all that the matter is feasible, that then we should tell you what plans and what safe-guards have been provided, and that we should give the public a chance to see what those are, and approve or disapprove them.

Mr. Hilliard: Will that be before or after the Commission report to the various Governments on the feasibility? That is the point.

Chairman Gibbons: That is a question that I am not going to answer for the Commission. My own idea was to suggest that it might be possible to make a report that under certain circumstances—following much the line of Mr. Kennedy's remarks to-day—that under certain conditions and subject to certain provisions it was feasible.

Mr. Hilliard: Excuse me if I do appear dense, but I want to be at one with you. How can the Commission report on the conditions and the safe-guards, so to speak, without having all the detail plains?

Chairman Gibbons: The engineers of our Commission and the engineers of the Government, who ought to know what they require, have thought that they had quite sufficient detail to enable them to form an opinion on the general character of the undertaking, subject to certain conditions. I am not an engineer. Both the Government engineers and the engineers upon the Commission have thought that they had sufficient data to deal with the general question.

Mr. Hilliard: Then, Mr. Chairman and gentlemen of the Waterways Commission, it was this: In the first inception, in 1908, when the public, so to speak, were taken into your confidence and were invited to criticise the matter, they won't now have an opportunity to criticise the plans that have been submitted, of which you have received knowledge, and so to speak, that portion of the inquiry is withdrawn from the public, do I understand that, Mr. Chairman?

Chairman GIBBONS: I don't understand that any definite plans have been submitted. I understand that they are only dealing now with the general proposition.

Mr. HILLIARD: What we would ask, then, from the Commission before they make any report, and what I would urge more strongly, is this: The public on both sides of the boundary line, I understand, has been admitted into the confidence, so to speak, of the Commission, and they have been promised that they will have these details of the plan or plans, no matter what they are. The promoters have convinced the enginneers' department, so to speak. All well and good. But I would now urge, that those plans at least be submitted to the public before there is any report from this Commission. That is to say, having once entered upon the process of investigating this matter, that there should not be any investigation, so to speak, between the engineers of the development company and the engineers of the government that will not go to the public before this Commission reports. That is the ground I take. It seems to me it would be most discourteous, so to speak, to the different parties who have been invited here to appear before the Commission, that the great and important part and the most important branch of the inquiry should, so to speak, be one in which the persons to the application should have a say with the Government, and the other parties only have an informal say, so to speak, or argument before the Commission. You can understand that.

Chairman GIBBONS: I think we do understand your argument.

Mr. HILLIARD: For instance, Mr. Chairman, I may seem persistent, but I urge that a private report of the Dominion Government to the Chairman of this Waterways Commission takes us at a disadvantage; it eliminates the very thing that we were here to criticise. If this is to be the end of the inquiry here, then of course, on behalf of the Ontario Government, we will have to carry it—with all due respect—we will have to carry the report some place else. But I should say that, acting as a Commission upon the part of the Government, in order to allay any feeling—I was going to say suspicion—this whole matter ought to be threshed out here; that we should not be promised a thing and then have it taken, as it were, by a side-door into the Government, and then by the Government to the Commission, and then we be ignored, and then that these Bills are reported upon in Parliament after the Company is incorporated; and then, forsooth, all the powers given to them, and in the matter of details and of plans what remedy can we have then? I submit that there should be something given to the people. I submit, on behalf of the Ontario Government, that there should be some provisions made, which should be submitted to us that we might criticise them before this Commission makes a report.

Mr. KING: Mr. Chairman, I find myself in a very, very difficult position. I did not like to be accused of backing and filling. There has been some backing and filling. I must, however, on behalf of the interests I represent, impress very, very strongly that there is no shadow of an assent to the proposal such as might have been gathered from my rather pleasant and acquiescent attitude a while ago. I made the statements I did under an understanding which now turns out to have been rather a misapprehension; and I try to set the matter right because I was disappointed—I say it with deference, Mr. Chairman—disappointed in the understanding that the Commission gave yesterday to our previous agreement. I set the matter right now because I do not want to be at some time told that to-day we agreed, on behalf of the navigation interests, that the thing was all right. What we said was that we were prepared to stand aside provided we were going to see all those plans. If there is no such understanding, then there is no agreement.

Mr. HILLIARD: There is a gentleman here from the vicinity of Morrisburg and Dundas, who lived there many years, who was brought up on the river, and would ike to give his information on that matter—Mr. Connolly.

Mr. CONNOLLY: Mr. Chairman and gentlemen of the Commission. I don't appear here representing any interests except myself. I have been a life-long resident of that locality, and have vested interests on both sides of the river at the present time. I wish to say to you that the old residents generally along that river, in view of their past experience with those floods, are in terror of this scheme. I am, for one. I have seen it on one occasion where an ice jam, apparently harmless at the start, took place above the rapids, filled that river from top to bottom, and caused great damage by flooding the lands for the space of 11 miles. There is no human agency that we know of that can take care of those ice-runs. There is something that we believe is beyond the power of any company or possibly any Government under some conditions. Now, as I understand it, the dam that is proposed to be built, the crest of that dam, is practically above the level of the upper reaches of the Cornwall canal. A horizontal line from the crest of that dam will come within ten feet of the surface of the St. Lawrence at Morrisburg, twenty miles, below that point. It is equivalent to a submerged dam over 20 feet high in the bottom of that river. Now you can see why we are frightened that that country is going to be deluged, how we are afraid of a catastrophy both to property and to life.

Mr. McCARTHY: Mr. Connolly, are you interested in any other power scheme in that locality?

Mr. CONNOLLY: No further than I have an investment in what is known as the Waddington Power. I formerly owned part of that power.

Chairman GIBBONS: I do not understand Mr. King when he says he does not withdraw his objections on account of some arrangement. I don't know, that there has been any change between yesterday and to-day. As I understand, the Commission is now asked—and the pressure is because of action in Congress—to give an expression of opinion upon the general effect. Because of the communication from Congress to the American Section we have had to deal with it. The Commission are unanimous, and have been all through, as I understand it, that if they do decide to express an opinion in favour they will suggest that one of the first conditions will be that plans should be submitted to them and should be approved of by them.

Commissioner CLINTON: And must be approved.

Chairman GIBBONS: And must be approved before being submitted even to the different governments for their approval. Of course we can only suggest this; and if they are submitted to us they certainly will be submitted to you and an opportunity given to criticise them. I don't know where the misunderstanding has arisen. I can only say that we will make this a condition of our report if we report at all in favour of the general scheme.

Mr. KING: Do we understand, Mr. Chairman, that that is a statement on behalf of the Commission, or the personal view of the chair?

Chairman GIBBONS: I spoke to General Ernst; I think that is the general view, is it? Do you agree?

General ERNST: I have no objection in the world to that, but it seems to e a very great waste of time. I do not see how it is possible for an assemblage like this to settle on the details of an engineering plan. We want to hear all of your interests, every possible objection you can make; but when it comes to settling the details of an engineering plan I do not see how to get ahead in an assemblage like this, that is all. But I have no objection at all to submitting them to you if that is your wish.

Mr. KING: Not necessarily in a general assemblage. If the various interests that are now diametrically opposed to the scheme were placed in a position to consult, with the assistance of experts, that is really what we want, more than an opportunity given in a meeting of this kind, which is admitted to be absolutely no opportunity at all, from my point of view.

Chairman GIBBONS: As far as I am personally concerned, as Mr. King will know, I am exceedingly anxious : I feel that you should have an opportunity and that you should avail yourselves of it by bringing experts who are independent, who can give us the benefit of their opinion before this Commission. Mr. King will know that that is the ground I took as far back as the original meeting in Montreal. I have been anxious all along that you should have the benefit of independent experts.

Mr. SMITH, K. C.: Would you allow the general manager of the Richelieu and Ontario Navigation Company to say a few words concerning his schedule of time?

Chairman GIBBONS: Certainly.

Mr. C. J. SMITH: In addition to the remarks of our counsel, Mr. Smith, I would like to explain the basis on which our time card has to be made, and which this scheme will affect. We are forced to a time card leaving Toronto after the trains have all arrived from the western gateways and the boats from Niagara, which is three o'clock. We then run a time card to Charlotte to connect with the trains leaving from that district via the gateway of Rochester to New York and Central New York State points. They are there soon after we arrive, and after we take passengers that are brought in to the Rochester gateway we go down to Kingston to make an early morning connection with the Grand Trunk sleeping cars that come in from the west with passengers who have not arrived at Toronto at three o'clock, but have come down from Chicago and the west in the day time, going through from Toronto to Kingston at night in sleeping cars, where we take them at six o'clock in the morning. It is a train connection. From there we run over to Clayton to get the passengers brought in by the New York Central Railroads to their different rail avenues, which trains arrive about seven o'clock. From that point it takes us all our time, being limited to those train connections to reach Montreal by daylight to connect with our Quebec boats leaving Montreal at seven p. m. These boats are obliged to leave Montreal at seven p. m. because they have got all their work laid out for them to reach Quebec and Levis through the ferry connections in the morning, to make rail connection for further points beyond, to the Intercolonial, Quebec Central, etc. Within the last five years the Richelieu Company, in order to bring this about and improve the conditions, and build up the tourist business, have been obliged to build new steamers of a modern type which will carry a much larger number of passengers and at a much higher rate of speed, because in these days you must give a service, even for tourists, that will take care of competition as against other water tourist lines and rail lines. Therefore, we are not alone; we cannot suit ourselves to these new conditions without injury. We are told that by using the new lock on the American side it will only take us about half an hour more to reach Montreal. That might be the case, or it might not be the case. We have no information to work on except the statements made by these engineers representing this power scheme. At the present time we have the advantage of currents before we reach the Long Sault, and advantages of currents after we passed the Long Sault. What time we will lose we cannot say. Our pilots are not able to get any information, although it was promised to us in the meeting in November, but it has not been forthcoming. We feel and I think we are right, that if they state half an hour, as we understand it, it is the half hour that will be lost in going through this lock. But supposing there are other big vessels there ahead of us, then we will be delayed that much longer. But we do not always reach Cornwall on time. We have fogs to contend with, we have to wait for train connections; and we wait to the limit, and we forge ahead; but if we are unfortunate enough to be delayed we have a certain amount of slack time. This slack time will all be taken up, and more than taken up if we are obliged to run through any locks. If we were obliged to run through the Cornwall canal eastbound, it would take four hours, and that would make it impossible to reach Montreal the same night because we cannot run the rapids after dark. We would have to cancel the trip when these tourists are coming into this country to see these rapids, and the result would be that our business from our principal asset would be destroyed. Our business originates in the west—the great bulk of it, 90 or 95%—and goes down in gradual steps and stages; and we claim that it is the attraction of the rapids that brings them here —the Thousand islands and the rapids and the chain. Now, if you break a link in that chain you injure our business, and we don't know what the result will be. We can say this much about it, that if we are unfortunate enough to have an accident or break down with our rapids boats, and we have to run the passengers by rail to Montreal, our business will drop off in the middle of the season from 300 or 400 people a day to 50. That is the reason I wish to bring the information as to this time card before you. It is all based on the time card, and we can only get our speed by leaving Kingston at six o'clock in the morning, and when days get shorter we have to leave Kingston at 5.30 in the morning. So that any impediment put in the navigation of this stream is a positive injury, and will result in very great and serious loss, and be a most difficult matter to overcome.

Chairman GIBBONS: Are there many more gentlemen to address the meeting, or are there any others who desire? If there are further addresses, possibly we had better adjourn for lunch. Are there any others?

Mr. McCARTHY: I don't think so.

Chairman GIBBONS: If there are no others who desire to address the meeting, I suppose the general meeting will close.

Mr. PRINGLE, K.C.: There is just one little statement I want to make in regard to what was said as to power in the east. I think it was made entirely under a misapprehension. I have in my pocket the correspondence dealing with that question of power. It was also stated by some gentlemen here that the east could get power at, I think, $12 per h.p. at the plant—I don't know the technical term. First it was stated generally at $12, and since then it has been modified to $12 at the plant. Now, I find the prices of power in this portion of Ontario to be contained in a document issued by the Hydro-Electric Power Commission of Ontario, power at the plant is somewhere from $9 to $10; at the point of distribution, it runs from $18 up to $29.50. We do not know where this plant is—it has been unheard of in so far as many of us in eastern Ontario know—but I have the correspondence which we had as a town with the Hydro-Electric Commission. We were most anxious to get power, and they could find no means of giving us power in that district. We suggested one or two possible schemes for power, but a letter came that the one scheme as suggested was entirely out of the question, and then there were some indefinite suggestions about some mythical and indefinite power at Waddington. When we came to investgate that—

Mr. Hilliard: What is the date of that, Mr. Pringle?

Mr. Pringle: This is 1906, and continued for some time. I want to say that these are the prices for power.

Mr. Hilliard: What is the date of that pamphlet?

Mr. Pringle: 1908.

Mr. Hilliard: It has been revised since.

Mr. Pringle: Now, the prices as given here for power vary, Toronto being the cheapest at $18.10, and running up to $29.50 at St. Marys, $26 at Hespeler, $24 at Berlin, $26.50 at St. Thomas, and so on. I may say to you, Mr. Chairman and gentlemen, that I don't think power at those prices would be of any great value at Brockville, Cornwall or the other towns in the eastern districts. Now, you have had great patience, and I know that I am trespassing a little, but if you will just bear with me a moment I will soon conclude. We have had everything up here, from manufacturing tacks to beef trusts, and we have got away almost untirely from the issue. I was more than pleased with what Mr. Kennedy said, for all over Canada we had the greatest respect for him. There is no man who is more conversant with the St. Lawrence river and its conditions than Mr. Kennedy, who for so long was connected with the harbour works of Montreal. I was very careful to note what Mr. Kennedy said, because it was the crux of the whole position. The question before you gentlemen is, 'Is this scheme feasible'? And Mr. Kennedy put it in a very nice and most comprehensive way, because he covered the whole thing that is before the Commission. He said that this work can be done wisely and safely. Now, is not that the whole position?

Mr. Hilliard: Would Mr. Pringle accept Mr. Kennedy's whole answer?

Mr. Pringle: Just wait, Mr. Hilliard; I did not interrupt you. Mr. Hilliard gave us a very earnest discourse; I would be very sorry to see our good friends at Morrisburg disturbed in any way by water. I think our engineers can meet Mr. Hilliard's views in regard to that. We are not dealing with that now, because I don't think it is pertinent here. It is not a question whether the gentlemen of Cornwall would accept Mr. Kennedy, or the Cornwall Board of Trade would accept Mr. Kennedy. I will tell you the confidence we have in Mr Kennedy; that when acting in the interests of the town of Cornwall we looked about for an arbitrator to represent us on one of the largest questions we had in the town of Cornwall, whom did we look for but Mr. Kennedy? That is the confidence we have in Mr. Kennedy; and Mr. Kennedy has stated that this work can be done wisely and safely. It is a question of detail to be worked out by the respective governments. I regret that somebody here had to refer to this company as 'foreigners.' Foreigners? Why, the men who are to-day at the back of this company have got invested in the Dominion of Canada from 2 to 3 millions of dollars. That money would have been invested right near the town of Cornwall if the town of Cornwall had been in a position to give them power. The first time I ever saw Mr. Davis was when he came to the town of Cornwall to see if there was a possibility of getting power. Now, look at our position; I will tell it to you in a nutshell. Notwithstanding what anybody has said here, there is not one horse-power to-day on the north side of the St. Lawrence river that can be developed. It is developed to the limit. There is not one horse-power on the south side of the St. Lawrence river at that locality that can be further developed; it is developed to the limit. We have now got to reach out into that river for development of horse-power. Representing as I do the town of Cornwall, my instructions are: 'Do everything possible to assist in getting the development of that power so long as Canadian interests are protected'. A great deal has been said here in regard to government ownership. Surely that is not a question to be dealt with here. I don't know what views our American friends take n regard to private ownership as against government ownership. I don't know what view the government of this country may take. Many of us as individuals favour private ownership with government control; many favour the other. I simply got up to correct an impression that may have got abroad that Cornwall at least—and I think I may speak of Brockville, may I not, Mr. Maclaren?—(Mr. Maclaren: 'Yes')—and Brockville had never been offered power at $12 per horsepower; and I think I may speak for Prescott and her manufacturers that such a thing has never been heard of. It has been got up here for the purpose of throwing a little more dust and creating a little more delay in getting this matter reported on simply as to the feasibility; and if we accept the evidence of the experts brought here by those who are endeavouring to get the Bill, and take the evidence of Mr. Kennedy, he frankly admits the scheme is feasible; all that is necessary is that it should be wisely and properly considered, and properly done. Surely we have got confidence enough in those who represent us in Parliament, that they will see that the interests of all parties are amply protected, and that every detail in every possible way shall be gone into before this scheme goes through, which we all admit is a very large undertaking. I thank you very much, gentlemen, for giving me these few minutes.

Mr. HILLIARD: I would simply reiterate Mr. Beck's promise. The Government of Ontario is at stake in that promise, and the Government of Ontario are prepared to back it up.

Chairman GIBBONS: I suppose the Government of Ontario hold out no offer to the people of New York?

Mr. HILLIARD: No.

Chairman GIBBONS: This is purely international matter, and I do not see that that can have a very great bearing. Is there anybody else who desires to address this meeting? If not, we will adjourn. The public meeting is now adjourned.

Meeting closed at 1.30 p.m.

APPENDIX 'C.'

PUBLIC HEARING HAD BEFORE INTERNATIONAL WATERWAYS COMMISSION, AT ITS OFFICE IN THE FEDERAL BUILDING, BUFFALO, N.Y., ON FRIDAY, MARCH 11, 1910, AT 2 P.M. IN THE MATTER OF THE POWER DEVELOPMENT AT THE LONG SAULT RAPIDS IN THE ST. LAWRENCE RIVER.

Present—

American Section: Gen. O. H. Ernst, Mr. George Clinton, Commissioners; Mr. W. Edward Wilson, Secretary.

Canadian Section: Mr. Geo. C. Gibbons, Mr. William J. Stewart, Commissioners.

Mr. James Logan of Waddington, N.Y., appeared before the Commission and asked permission to state his objections to the proposed development of power at the Long Sault rapids in the St. Lawrence river.

Chairman Ernst: We will be glad to hear what you have to say, Captain Logan.

Captain Logan: I am very much obliged and I must say I came away rather unexpectedly because we did not expect to have a hearing before you to-day. Yesterday I heard about fifteen minutes before train time that we would have a hearing.

Commissioner Gibbons: What I said was that I had no power to speak for the Commission, but that we would have a meeting here.

Captain Logan: We telephoned Mr. Allison at Ottawa. I live in Waddington, twenty miles above where this proposed dam is to be built, and we have a little power plant down there at Waddington, a dam that has been built down there for a hundred years. We think that if this dam was built out at the Long Sault that it would interfere with our dam, so at a public meeting of the citizens I happened to be the trustee, one of the trustees and president of the village, and we held a public hearing, and the citizens were unanimous in our making a protest to the Minister of War against the damming of this Long Sault.

I will just read here what we wrote the Minister and I must say that we are in a rather peculiar position with our member of Congress, Mr. Malby, who has introduced the Bill in Congress, and through him of course to the War Department we should have made our prayer, but we had to go direct to the Secretary.

Chairman Ernst: Is the paper lengthy?

Captain Logan: No. It isn't very lengthy. It won't take but a short time. I should have expected to have had a lawyer from Waddington who would have put this in kind of ship-shape. I am just an ordinary steamboat man.
(Reading)

Washington, D.C., Feb. 3, 1910.

To the Honourable Secretary of War,
Washington, D.C.

Sir,—At a public meeting of the citizens and tax-payers of the village and town of Waddington on the St. Lawrence river, the following protest was unanimously adopted, and ordered to be sent to you. As president of the village of Waddington, N.Y., representing the inhabitants thereof, I desire to protest against the damming of the Long Sault rapids by the company who are proposing to do so.

Waddington has a dam between Ogden's island and the main shore, giving us a water-power which drives our mills, electric light plant, etc., and this dam has been in existence nearly a century, commenced in 1808, finished in 1815, sometime before the grand system of Canadian St. Lawrence canals were talked of.

A lock of small size was also built there, but owing to some defect in construction was not used. For years Waddington was the chief centre of manufacturing for a large territory on both sides of the St. Lawrence.

Now, sir, should the damming of the Long Sault rapids be done, it would naturally slacken the speed of the current above the rapids and raise the water. Then in the winter season, which unfortunately is long and cold, heavy ice forming along the shores and in the bays, narrows the channel between the shores so that the floating of anchor ice and the formation of frazil causes jams between the main shore and island shores, blocking the channel and raising the water above the blockade. Within the last thirty-five years we have had four serious ice jams, from as far east as Croil's island, raising the water from normal winter level to nine or ten feet above, putting our power plant out of business entirely.

Now, with a dam at the Sault rapids, this condition, or worse, would unquestionably take place every winter, and the loss could not be estimated, for the reason that no one could tell how high the water might rise, or where it would go when the highest point was reached and the water overflowed. The last jam in 1905 was the most serious to property owners along both the American and Canadian shores, from Louisville Landing to Waddington and Farran's Point to Morrisburg and hundreds took the trip. The daily returns of the lock-master at Morrisburg, Ont., will give the water level for February, 1905.

Then again as a navigator of the St. Lawrence, having had some 40 years service and enjoyed many a trip down the 'Rapids' in behalf of the millions of Americans and Canadians who have not had the pleasure of a St. Lawrence River trip, but want to take it in the years to come—in behalf of those, I say, do not allow any obstructions to the navigation of the grand old St. Lawrence if in your power to prevent it.

Yours very respectfully,

James H. Logan,
President of Village.

A. B. Shepard,
Secretary.'

That was the protest from the village. Then if you will allow me, this is just a short letter, this is a personal letter:

'February 3, 1910.

To the Honourable Secretary of War,
Washington, D.C.

Sir,—In connection with the enclosed public protest from the citizens of the town and village of Waddington, I wish to add a few words further for your information.

Waddington is situated within about thirty miles of the very most north-easterly corner of N. Y. State, where the boundary line between the U. S. and Canada leaves the St. Lawrence river and runs southeasterly through the land, from the Indian Village of the St. Regis Reservation, so that the Long Sault rapids is the last and most important rapids over which the U. S. Government has any control, and with its fall of 48 or 50 feet from the head of the rapids to the St. Regis boundary, a distance of about 15 miles, with the speed of 20 miles an hour of current in the pitch of the rapids especially on the north side of Long Sault island or what we boatmen call the Big Sault, these rapids act as an immense safety valve to carry off the ice and slush which accumulates in the open river from Ogdensburg to Cornwall a distance of some 50 miles.

The Galops rapids nine miles below Ogdensburg with a current speed of ten miles and Rapid Du Plat directly opposite Waddington on the north side of Ogdens island with a 10 or 12 mile current, both act as agitators and keep the ice and slush moving down stream, and should never be abstracted in the navigable waters. Gooseneck island is three or four miles below Waddington and at present an ice bridge has formed from the south shore of the island to the American shore, and teams are crossing back and forth. But the main channel, wider and deeper on the north side is still open and we hope may so remain. We will all be anxious about the ice river conditions, while the cold weather lasts. I understand that a Bill to legalize the damming of the Sault rapids, is now before our Congress in Washington. If that is so, I would most respectfully ask that you give the matter your immediate attention and send one of your engineers to look the situation over now, while we are in the danger zone.

Waddington, St. Lawrence Co., N.Y., can be easily reached by railroad, N. Y. Central from New York to Norwood, and the Norwood and St. Lawrence to Waddington.

We will render every assistance in our power to any one you send.

Yours very respectfully,

CAPTAIN JAMES H. LOGAN,
Waddington, N.Y.
St. Lawrence County.

Now, this was the answer that I got from the War Department:—

War Department,
Office of the Chief of Engineers,
WASHINGTON, February 19, 1910.

CAPT. JAMES H. LOGAN,
Waddington, N.Y.

SIR,—1. Referring to your letter dated February 3, 1910, and protest enclosed therewith of the village of Waddington, N.Y., against the construction of a dam in St. Lawrence river at Long Sault island, I have to inform you that before a dam can be built at the locality mentioned, it will be necessary to obtain authority from Congress for its construction. If authorized by that body, the War Department, in consideration of the matter, would be limited to such features as affect navigation and are specifically provided for in the law.

2. A bill providing for the construction of dams, etc., at Long Sault island is now pending in Congress, and it is suggested that any representations which you desire to make in opposition to the measure be made to the committee having consideration of the Bill in charge, namely:

The Committee on Rivers and Harbours of the House of Representatives and the Committee on Commerce of the Senate.

By direction of the Chief of Engineers.

Very respectfully,

J. B. CAVANAUGH,
Major, Corps of Engineers.

662422.25'

Now, if you will just allow me to read our answer to that—

Chairman ERNST: You are going to file those papers, are you, Captain?

Captain LOGAN: Well, these are just copies that I kept of the letters that I sent to the Secretary.

'Waddington, N.Y., March 8, 1910.

THE HONOURABLE SEC. OF WAR,
Washington, D.C.

SIR,—I beg to acknowledge the receipt of your letter dated February 19, through Major Cavanaugh, of the Engineers, referring to the petition of the village of Waddington, N.Y., dated February 3, 1910.

We note that you state that the War Department would only be interested in the Bill now before Congress in so far as it would affect navigation, etc.

In respect to the above, we wish to call your attention to the following points which we believe, from our past experience and our knowledge as residents right on the banks of the river, that should the proposed dam be built, it would very seriously impair the navigable rights of the river and cause much destruction to the bordering property, both public and private.

Examination of the plans of the company shows that it is quite possible that serious damage would result from the construction of the proposed works. Engineers have, it is true, given an opinion that there is no probability of such damage. On the other hand, the opinion of the residents along the shore and of the most experienced navigators and observers is almost unanimous in holding that the probability of serious damage is very strong.

With all respect to the engineers who have given their opinion, it is submitted that the question is not an engineering problem, and that no data exists for the formation of a reliable engineering opinion. No engineer can tell where and how ice will be forced when in our rigorous winter climate, the flow of a mighty river like the St. Lawrence is interfered with. It is a fact that five years ago, when an ice bridge formed on both sides of Croils island, the river just filled up with ice for twelve miles above, and great damage resulted, and had the cold weather held for two or three days longer, the low-lying farms and islands would have been wiped off the map; and the Long Sault rapids was working full time. There was no interference there.

The serious ice jams which in past years have done so much damage, would become a yearly occurrence and completely ruin property along the banks of the river on both the American and Canadian sides.

The possible total stoppage of the flow of the river within its banks, as a consequence of the contemplated works, is a contingency which cannot be said to be impossible or remote. The destruction caused by such a stoppage is beyond the imagination.

It does not appear to me to be necessary to express an opinion as to whether the weight of evidence or probability is in favour of the view expressed by the Engineers for this proposed dam, or that of the residents of the locality, who have intimate knowledge of the history of the river for many years past. The fact there is any—even the slightest—difference of opinion would look to me as a sufficient reason for considering the proposal. No risk should be taken in a matter of such vital importance, national and international. Then again, the proposed plans will change the entire chart for navigation purposes below the Sault rapids.

The present course through the rapids will be entirely changed: all boats will be obliged to pass through the locks. The pilots who navigate this section of the river are unanimous in the opinion that the current below the dam will be too swift and the channel too intricate for ordinary craft heavily loaded to even go down stream and no possible chance to come up.

We are satisfied that if your Department, or Congress, would investigate this matter from a purely neutral standpoint, having due regard to the views expressed by the most reliable life-long residents of this district, the decision would be: *No damming of the Long Sault will be considered.* Surely our Government will not allow any of our rights in this 'National Heritage' to be usurped by any private corporation for their own selfish ends, without giving it their usual careful consideration.

We find ourselves in rather an awkward and peculiar situation, inasmuch as our representative, Mr. Malby, introduced the Bill now before Congress. Thus my appeal to you direct in behalf of the residents of the village of Waddington, of which I have the honour to be president.

Yours very respectfully,

JAMES H. LOGAN

That is our case. That is, as far as we have gone.

Commissioner GIBBONS: You do not think the interests of navigation would be improved by this damming of the river?

Captain LOGAN: I certainly do not.

Commissioner GIBBONS: Make still water where there are rapids you do not think would be an advantage?

Captain LOGAN: Oh yes, certainly, but it would not make still water; it would not make still water below the dam.

Commissioner GIBBONS: The flow there would be the same.

Captain LOGAN: Oh, the flow would have to be the same. The water has got to go somewhere and the channel below the Long Sault rapids runs all the way down to Cornwall to the foot of Cornwall, it is just about as tortuous as it can be. Just below where they propose to put the dam there is a short turn, at what we call Pikes eddy, where the current runs against the bank and then right out around this sharp point is a shoal which narrows the channel up to not over 400 feet, and then down about three miles below, at Hawkins Point, there must be good ten miles an hour there and in a narrow channel, but of course it is deep up to both shores, up to the island shore and the main shore.

Commissioner GIBBONS: You do not think it would be possible for boats to navigate up stream there?

Captain LOGAN: No, I don't think so. There isn't water enough anyway down between Crab island shoal, which is right in the middle of the river, and of course on the north side there is a narrow channel and on the south side there is a narrow channel; but a single boat might come up if it had power enough, but any boats we have on the St. Lawrence wouldn't come up there with a load; not a freight boat on the St. Lawrence would come up there with a load in.

Commissioner GIBBONS: What about going down?

Captain LOGAN: Well, I say I do not believe it would be possible to take a boat down with a big load in. I do not believe the insurance company would give any insurance on a cargo going down the river below the Sault.

Commissioner GIBBONS: There is no freight boat—yes, they go down through Farran's Point.

Captain LOGAN: Yes. It is just as strong, rapid current, but they are straight. They are straight and of course Farran's Point is very deep; it is narrow, and it is a bad place.

Commissioner GIBBONS: Do they attempt to come up at these points that you are speaking of?

Captain LOGAN: They go round Farran's Point to the south. Few of them will come up there.

Commissioner GIBBONS: What do I understand to be your statement as a navigator in respect to this: the one lock would be an improvement on seven?

Captain LOGAN: Yes.

Commissioner GIBBONS: But where would you be after you got through the one lock as compared with the seven?

Captain LOGAN: You would be about a mile below the head of the Cornwall Canal.

Commissioner GIBBONS: Is that mile a very objectionable feature?

Captain Logan: We do not use it at all now. It is a very heavy current.

Commissioner Gibbons: I mean would it be if you had put in one lock, would that one mile be hard to navigate?

Captain Logan: I couldn't say what the speed of the current would be from the lock to the head of the canal; it might slacken down. As it is now you couldn't come up with a boat.

Chairman Ernst: You mean the foot of the canal?

Captain Logan: From the breast lock to the head of the canal.

Chairman Ernst: You are speaking of the head. You mean the foot?

Captain Logan: No, I mean the head. You are not coming up from the new lock?

Commissioner Gibbons: No. I mean to go down from the new lock to the foot of the Cornwall canal.

Captain Logan: Oh, well, that is what I am talking about. It wouldn't be possible I don't think either to go down or come up.

Commissioner Gibbons: Of that mile stretch?

Captain Logan: Oh, this is 12 miles.

Commissioner Stewart: Would there be any objection to putting a dam further down; suppose the engineers found they could place a dam a little further down the river say below or on the Crab Island shoal?

Captain Logan: If they could do that, if they could put it right down at the foot of the canal.

Commissioner Stewart: Abreast of Cornwall.

Captain Logan: Yes. I don't know how far the slack water would extend from the dam up to the present Sault. I guess they would have to build a pretty high dam. There is 48 feet of fall from the head of the Cornwall canal to the foot.

Commissioner Gibbons: Then you would think that the advantage of having one lock instead of seven would be done away with because here that 12 miles after you went through the lock you couldn't navigate.

Captain Logan: No. Couldn't navigate below that lock, not to put it at the foot of Long Sault island.

Commissioner Gibbons: Well then, according to you the lock would be no good at all if you couldn't navigate it when you got down.

Captain Logan: Well, there is nine feet at Point Moulin right abreast and under the present bridge that goes across there, the New York and Ottawa Railroad bridge, about nine feet of water there now, normal water. I think the bridge has about sixty feet head run, a boat with a spar sixty feet could go under it, and there would have to be a lot of dredging done and blasting done before you could get down at Cornwall island.

Commissioner Gibbons: Supposing the dredging were done?

Captain Logan: And the bridge raised.

Commissioner Gibbons: We will assume that, yes.

Captain Logan: That would help it, of course.

Commissioner Gibbons: Then do you think you could navigate?

Captain Logan: You could navigate there, but I don't think you could navigate around those short turns.

Commissioner STEWART: Crab Island shoal.

Captain LOGAN: Yes, and above there, just around the head of Barnhart's. You know there is a heavy current there, there must be right in the middle of the current, 12 miles an hour of current. I never had a current meter in there, but I should say from coming up alongside there must be a twelve mile an hour current and there is all the way up to the foot of the Long Sault; I have navigated the Long Sault rapids with small boats; you can only go down with about seven feet and go down the South Sault and then swing around the boat of Long Sault island and come up into the north, just for fun, just to get the swells there at Sheek's island; but take a big boat with a load in, 225 feet long, loaded to 14 feet, which is our St. Lawrence draught now, I think it would be mighty risky to attempt it. I wouldn't want to do it.

Commissioner GIBBONS: Would a further dam down at the foot of the canal help any? Do you think in your opinion could there be any manner of improvement by damming there that would help navigation? It has been suggested by a very eminent engineer, Mr. Kennedy from Montreal, that it is feasible to improve navigation by damming these rapids and thereby creating comparatively still water; that he thinks it is feasible, not under this particular plan or any particular plan, but that it can be done. Your idea is that it is not feasible.

Captain LOGAN: I will tell you, a series of dams might do it, one at Crab island and one at Point Moulin, and another at the foot of the canal; that of course would make intervals of still water and do away with the heavy current around Barnhart's island, and there is the principal point to my notion, getting around that shoal; of course that would have to be taken out, that would have to be dredged, but if the whole river was widened out and deepened it certainly would be more feasible to navigate it.

Commissioner GIBBONS: You will see I am getting information, at the same time I am very glad to get it.

Captain LOGAN: I do not want to set myself up against any engineer.

Commissioner GIBBONS: You quite concede that if navigation could be improved it is very desirable to develop this power.

Captain LOGAN: Yes. Well, sir, if it could be improved and no damage done—of course I am interested in one end of it, Morrisburg, because we are expecting to have a big development at Waddington. We have a railroad we have been waiting for for forty years and it looks as though we would have a new dam there and a development there, and our present dam is no use if we have back water.

Commissioner GIBBONS: And yours is a sort of a rival proposition?

Captain LOGAN: No, it isn't a rival proposition, because it was in existence for 100 years, the first dam in the St. Lawrence; it is between Ogdens island and the main shore; it cuts off the south side of the river at Ogdens island.

Commissioner STEWART: What head have you there?

Captain LOGAN: 11½ feet.

Commissioner GIBBONS: You say this would interfere with that?

Captain LOGAN: Yes.

Commissioner GIBBONS: It would interfere with the head.

Captain LOGAN: If the water backed up, if the ice formed from the dam at Croil's island, which I think it would in case the Soo is dammed. Our idea was that if we got this dam in and got a good development and had to use this power we would have a power for the ice tug to keep the ice broken up between Croil's island, Gooseneck island and the other islands so that there would be no formation, so that the water couldn't back up.

Commissioner Gibbons: Would it be feasible, if this scheme is otherwise desirable, to prevent ice forming in the Long Sault using ice breakers ?

Captain Logan: If that was done we couldn't make any kick if we weren't interfered with as long as the ice is kept moving.

Commissioner Gibbons: Do you think that is feasible?

Captain Logan: Well, I should think it would be. I don't see why it wouldn't.

Commissioner Gibbons: If there were ice breakers used, if that were a condition of this development, you would have no objection as far as Morrisburg is concerned?

Captain Logan: No, if these ice breakers would keep it open, and I don't see why they couldn't.

Commissioner Gibbons: Then your only objection would be that it would not improve navigation.

Captain Logan: That is all. It would certainly damage the low-lying shores and islands, and if the ice ever filled up as it did five years ago and remained there all winter; three days more would have put our Morrisburg canal out of business. I tell you we were pretty anxious standing on the bank and seeing that ice jam, and we never had an ice bridge between Morrisburg and Tree island directly opposite three miles below Waddington, never had an ice bridge there in the memory of the oldest inhabitant.

Commissioner Stewart: Aren't those ice bridges formed by the residents there?

Captain Logan: No, not this last time it wasn't. It was formed naturally, a very heavy westerly wind raises the water there. I have seen it raise in the summer time, raise two feet in ten hours, and of course it happened to do the same thing this winter, and there was an ice bridge just below Alts Fly and the water raised the bridge and it swung around and went down on the north side of Croil's island down there and Farran's point and jammed up to Baker's point and the anchor ice filled in and the wind went down and lowered the water, and an easterly wind struck up, and then we had a snowstorm with it and that made the slush ice and it filled it on the south side and jammed up both sides of Croil's island, and then of course the weather held for about ten days severe cold weather, and they were breaking the ice at Ogdensburg with the ferry boat there, and that of course was going down all the time, and these boats kept breaking away and filled up 12 miles.

Commissioner Gibbons: Is there anything to prevent under any conditions, an ice breaking steamer operating between Morrisburg and this Sault lock?

Captain Logan: No, nothing to prevent it.

Commissioner Gibbons: There is no current?

Captain Logan: There is the usual current.

Commissioner Gibbons: But not too heavy?

Captain Logan: No.

Commissioner Gibbons: And the ice never forms.

Captain LOGAN: No, not but what a boat could break it up. Captain Murphy, who ran the ferry there for thirty years between Morrisburg and Waddington, had the ice breaker built; she used to go down one side of the island, and if the bridge did form on the opposite side he would come up under below and break it out and start it away. He did that several times, but of course we haven't any ferry there now, business doesn't warrant it, and there was nothing done the last time, it just filled right up.

Chairman ERNST: If that is all, Captain Logan, we will call the hearing closed.

APPENDIX D.

PUBLIC hearing held by the Commission in Toronto, on Friday, April 15, 1910, on the project of the Long Sault Development Company.

TORONTO, April 15, 1910.

The following members of the Commission were present:—

Canadian Section: Geo. C. Gibbons, Esq., K. C., Chairman, Louis Coste, Esq.

American Section: Brig.-Gen. Ernst, Chairman, George Clinton, Esq., E. E. Haskell, W. Edward Wilson, Esq., Secretary.

Chairman GIBBONS: Mr. Lynch-Staunton is here, representing the Ontario Government. We arranged to meet him to-day in reference to the Long Sault matter.

Mr. G. LYNCH-STAUNTON, K. C.: Mr. Chairman and gentlemen, I am here, as Mr. Gibbons has stated, for the Ontario Government. I have very little to say to you concerning this question, but I want to put before you the position which this Government takes. I recognize that any questions which may arise between ourselves and the Dominion Government are matters of pure indifference to you; that it is only the international questions with which I presume you will deal. Now, we claim that the Ontario Government is the absolute owner of all the water of the St. Lawrence river in the bed of the stream, and the fishes that float in that stream, in so far as Canada has any claim to that river. In other words, we claim that, as between us and the Dominion Government the waters of the St. Lawrence belong to us; and I take it that that goes to the thread of the stream, or to the international boundary. If that contention of ours is right—and we think that the British North America Act bears us out, as illumined by the judgments of the Privy Council—we think that any application that is made to dam the St. Lawrence at the point in question here should be made to this Government. We recognize, of course, that the Dominion Government is paramount in questions of navigation, and that the Dominion Government has the right to legislate, and is the Government, if any, which must treat with the United States. I am not familiar with the state of the law as to the right of New York State, but as I understand it the people of New York State own the water in that river, if a State or a State Government can own the water in a great highway such as this is. Now, from my information, I am not capable, and I would not for a moment presume to argue with this Commission as to the advisability or inadvisability of granting this right; but I have had the advantage of reading the report of the engineers deputed by the Dominion Government to examine and report on the feasibility and advisability of Canada consenting to the damming of the St. Lawrence by this company—

as I have no doubt you gentlemen have read these reports—and if one can place any reliance upon the first reports, it would be utter madness from an international point of view to allow this work to go on at all. But they point out various reasons for it, amongst others the chances of this dam being carried away—that is the dam that goes over the main channel—and the ice that will certainly gather in the Long Sault Rapids, with the result of flooding over Cornwall and destroying the lower canals and the reaches of the St. Lawrence, and flooding the islands, and all those various dangers that they anticipate. With no uncertain sound they lay it down that that would be the result. They have made a second report in January, 1910, and in that report they set out none of their reasons; but they modify their report very substantially, and they say that if the plans are amended, and various other recommendations that they make are followed, then the damming might be permitted Now, the Government of the province of Ontario has never had any of this material put before it; it has never had the advantage of examining the plans, and is absolutely in the dark excepting what I have been able to pick up as to the plans of the promoters of this scheme. While I am not for a moment speaking disparagingly of the report, or casting any doubt on the report of those gentlemen, yet if that report is reliable, I think that very, very cogent reasons and explanations should be given to the Governments which are charged with the duty of preserving this waterway, for departing from the recommendations made in the first report. In the second report there are no reasons given whatever that one can follow without the report being interpreted to them by the engineers who made it. For that reason, and for that reason alone, I ask as a matter of courtesy to the Government of Ontario that the International Waterways Commission stay its hand and make no recommendations whatever to either of the Governments of Canada or the United States or of the State of New York, of their opinion on this question, until the promoters have furnished us with all the data that they have or intend to furnish this Commission or the two Governments. We contend that we have a very great duty to perform to the people of the province of Ontario. The water, we contend, belongs to us; we have a proprietary interest in it, and it is all within our territory—the Canadian portion of it—and I believe it is only reasonable that this Government should be given all the evidence that has been laid before the Doninion Government, and all the data on which this Commission is asked to form its judgment; and that after that, we should be given an oppurtunity to criticise that material before you. Now, I know that I am speaking to engineers of great eminence; and as I know as much about engineering as a pig does about navigation, I will say no more except to point out to you, gentlemen, that electrical engineers of the greatest eminence in the United States were engaged in the construction of those works in the Niagara river, and the Governments were advised by men whose judgment was as infallible as it is possible for human knowledge to bring a man to, and those engineers thought it was perfectly safe to allow the Ontario Power Company to construct its works on the Niagara river, yet we know that as a result of that construction there was a jam in the Niagara river this last winter or the winter before last such as has never been heard of before. That jam nearly destroyed the property of that Ontario Power Company, and created great alarm on both sides of the river for a long time. I just point this out to you to show that even the most experienced men, when dealing with great forces like these, are liable to go at least a little astray; and we feel a deep fear and concern as to what may happen if the St. Lawrence is dammed—that is, from the point of safety to the public. Then, as we feel that we have a proprietary interest in half the water, we think that before us should be laid all those plans that I speak about, and we should be given every opportunity to criticise them and give our opinion, and ask that due weight should be given, as I am satisfied it will be, by this Commission. Now, I know that there has been a good deal of criticism of this. Other gentlemen have been before you, and you are far more familiar with the question than I am, and I have only come here for that simple purpose—to assert our right, and ask as a matter of courtesy to this Government that the request I make to you will be granted before you act in the premises. I think I have nothing more to say, and I thank you very much for your kindness in having heard me.

Mr. COSTE: Where was this dam in the Niagara river?

Mr. LYNCH-STAUNTON: It filled up the whole river.

Mr. COSTE: In the mouth?

Mr. LYNCH-STAUNTON: Yes. The idea that I have heard put forth by the engineers is this: As the cutting of the canal of the Power Company comes around, the water rushes into the canal below the fall. They said the result was that this water running in there formed a wheel-belt and thus coagulated the ice, which, instead of being in small parts—in the form of snow, in fact—went down the river in great icebergs, which gradually built themselves up until they jammed the river. That was the theory and the solution g ven to me by an engineer of eminence.

I know no more about it than that, but I am told that it never occurred in the history of the Niagara river before.

Mr. COSTE: Oh yes, frequently.

Mr. LYNCH-STAUNTON: That is the ice-bridge. I am not speaking of the ice-bridge.

Mr. COSTE: Yes, the ice at the mouth.

Mr. LYNCH-STAUNTON: Well, I don't contradict you, but I know that this engineer so informed me, and he made a great study of it and reported to his Company, and he told me that such a jam as this had never occurred before in the memory of man. He may be in error, but he gave me that as a fact.

Mr. G. H. MELDRUM handed to the Chairman of the Commission the following memorandum signed by J. Wesley Allisón, and Irwin Hilliard, Counsel for Ontario, and on behalf of Morrisburg and Williamsburg:—

MORRISBURG, Ont., April 14, 1910.

To the International Waterways Commission,

GENTLEMEN,—On behalf of the Municipalities of the Village of Morrisburg, Township of Williamsburg and Township of Matilda and all the farming communities between Mille Roches and Prescott, the following arguments are submitted as a protest against the Commissioners consenting to the construction of the proposed works in the St. Lawrence river at the Long Sault rapids.

The Commission has so far given several hearings for the purpose of investigating the scheme, but at these meetings the discussion relating to the details, which are the very essence of the plans, was so curtailed by the Commissioners that very little information could be gleaned from the Company's representatives. As the Company volunteer only the most vague outline of their project, it is certainly placing the opposing interests in a very disadvantageous and unfair position to force them to discuss this question when so many new objections present themselves as the Company's plans are unfolded.

At a former hearing, it is true that the Commission offered to defray the expenses of an engineer to aid the opposing forces, but this suggestion simply means that we would be forced to devise or design for the company plans of his own which would do the least harm to the various interests involved. It is entirely out of the question to ask any engineer to give an intelligent opinion on the merits of the scheme from the crude data furnished at these hearings. It is clear that the above plan is not practical but that the Commission should make public all those plans and figures which have been submitted by the Company or force the Company to reveal for public investigation its plans in much fuller detail and prove conclusively to just what extent all possible interests would be damaged or injured. As long as the public are not allowed access to all the details necessary to form a satisfactory estimate of the effect of the project just so long should the Commissioners in our opinion delay any decision that might in any way be favourable to the Company.

From former discussion on this subject before the Commission and from data collected in the vicinity of the proposed works the following arguments are believed to be in accordance with the views of the great majority of the people in this district bordering on the St. Lawrence river.

1. The Report of the Canadian Government Engineers dated December 15, 1908, sweepingly condemned the essential parts of the proposed scheme and on January 13, 1909, when they reported on the modifications which had been made in it as a result of their criticisms, there was a noticeable betterment in the conception of what Canadian rights amounted to but not to an extent which permitted Messrs. Butler, Lafleur and Anderson in any way endorsing the amended proposals as satisfactory from a Canadian standpoint. How much more pruning from the initial ideas of the promoters would be required before the proposition can be expected to appeal on its merits as fair and equable, remains to be determined by careful study of very complicated conditions. It is doubtful if the promoters would accept the concessions allowed by plans revised by a Commission of Engineers whom they could not influence, after an exhaustive study of the whole situation.

2. Ice jams with their floods.

The St. Lawrence is unique in that it is the only large river in this northern climate having its open stretches so well provided against ice troubles. Especially is this true of those sections above Montreal. The lakes at the outlets of each of these sections form a dumping ground for all the ice which is delivered and nature has provided them with a sufficient capacity to take care of all ice carried down and manufactured in the open stream above. In severe winters that the lake levels do rise considerably is shown by the floods in Cornwall due to Lake St. Francis filling up with ice. The longest and worst stretch is that between Prescott and Cornwall which has forty miles of open water besides three rapids, namely, Galops, Rapide Plat and Long Sault. The amount of ice delivered by the Long Sault before the breaking up of the lakes is probably as much as that delivered by the Cedars and Lachine combined. This is on account of the much longer and wider stretch of agitated water, where the frazil ice forms; the numerous bays for borderage ice and the large tracts of snow-swept lands and ice-fields for slush ice. The swiftness of the current keeping the mass in constant motion alone prevents the accumulation from uniting, but when a narrow portion of the river has become bridged by some large field swinging out from one shore and striking the other side, then the arrested mass soon cements and quickly creeps up stream. That its disastrous effects are to be dreaded is evidenced by the memorable seasons of 1879, 1887 and 1905. In the latter winter the bridge began towards the end of January and extended ten miles up stream to Rapide Plat raising the water twelve feet at Morrisburg and affecting the river level as far as Prescott. That the tendency for the jams to occur in the slackened current due to damming the river is self-evident. But, in addition, the problem of guiding the ice accumulation (consisting of cement-acting slush and cakes of ice ranging up to twelve and more feet in thickness) over any dams or through any sluices is something for which there is not any precedent for engineers to calculate upon. Past experience has shown that, with twelve hours start, after a bridge has formed it would be impossible for ice breakers or dynamite to be effective, but that only the warm spring weather would prevent the upward march of the ice, carrying destruction beyond the imagination of any one. The possible total stoppage of the flow of the river as a consequence of the works contemplated is a contingency which cannot be said to be impossible or remote. All the scientific world know of the investigations and means employed to break up the jam in the Niagara river last year, and every one has heard of the strenuous but unsuccessful effort put forth by the Canadian Government to keep free the lower St. Lawrence of its ice and maintain an open channel. The damage incurred by the jamming of the channel below the lower rapids (Coteau, Cascades and Lachine) and that often taking place in Montreal harbour gives a faint idea of the responsibility entailed by arresting the flow of the river. From past history we believe that the force of the flood incurred by the recent overflowing of the river Seine in France, would be nothing as compared to the power of the much greater volume of water that would overrun the shores of the St. Lawrence if its natural channel were blocked.

3. River Levels.

The proposed plans will seriously affect the levels of the river above any dams by causing the water to back up; how far it is difficult to determine. This will entail a heavy loss on those municipalities who have spent large sums on their highways, depending upon the very uniform flow of the St. Lawrence in the past; more particularly will this be felt during the seasons of high water when many of the farms on the Canadian shore (which is much lower than that on the American side) will be flooded; all the docks and canal embankments which have been built in accordance with the present state of the river will require readjustment in height and new facing on account of the higher wash of the river water. During seasons of low water the effect of the dams will tend to keep the water higher and thus cause a high tail race, or lessen the head in all the low head power plants in this section. A Government chart of this section of the St. Lawrence River prepared in 1896 for the Canadian Government shows a fall of only 10·85 feet in the distance of 15·7 miles from the foot of Morrisburg canal to the head of Cornwall canal or an average fall of only 8 inches per mile. This shows that even a low dam in the river would cause a noticeable effect in backwater conditions.

That the discharge over the dams will be equal to the present discharge through an unobstructed channel requires very careful investigation of the characteristics of the river, but it is a fact that any plans which will make backwater to be felt for even a few miles upstream from the Long Sault will cause a smaller discharge over the weir and thus interfere with the depths of the river from Cornwall to the sea level. Your Commission recently condemned the placing of a submerged weir across the foot of Lake Erie on account of affecting the waterways; and their conclusion, after a very thorough investigation, shows that the low water stages of Lake Erie would be raised about one foot; that of Lake St. Clair .61 feet and Michigan .27 feet while the oscillations in Lake Ontario would be increased 5½ inches and low water would be made lower by 4½ inches and the depth of the St. Lawrence canals would be diminished by about 6·6 inches. The above decisions show how seriously the levels both above and below any dam will be affected by that impediment.

4. Navigation.

At present 95 per cent of the whole flow of the river passes down the main channel between Long Sault and Barnhart Island and the proposed upper dam will divert 55 per cent of the total flow of the river channel which, at present, carries only 5 per cent, leaving only 40 per cent passing through the upper dam by sluices. The reduction of the main channel flow ⅗ of its present volume, will have an effect of indeterminate extent upon the navigation of the channel below the proposed South Sault lock. So far as the navigation of the main channel below the proposed South Sault is concerned, the abstraction of $\frac{3}{5}$ of the present flow will create a condition, which if not indeterminate, is at least problematical and it is impossible to state what percentage of the total flow is required to make navigation as safe as under the present conditions. It may be claimed that this 40 per cent overflow is only given as an arbitrary figure and could be regulated by the sluice gates and increased to whatever volume is necessary to make the main channel safe. This is quite true, but at the same time we must not lose sight of the fact that the water flowing in this manner is absolutely lost as far as hydraulic power is concerned. Thus, according to the company's own plans and estimates, at least 40 per cent with a possible 90 per cent of the total existing energy would be lost. The proposed works would be of a permanent nature, and once constructed in this manner it would be hard to alter the scheme of development so as to utilize a greater percentage at least if not all of the available energy.

An important point that must not be lost sight of is the physical character of the channel below the South Sault lock. At present, crafts utilize this channel going down stream only, and then with considerable difficulty, on account of the sharp turns, swift course currents and shoal places. At present pilots with river boats find great difficulty in making the westward trip in that part of the channel below Barnhart's Island, but how the larger vessels could navigate this and a much more swift and intricate passage immediately below the sight of the proposed locks is a problem that many engineers and navigators claim cannot be overcome.

The Canadian section of the Deep Waterways Commission insist upon a Canadian lock, but the available sights are made secondary to the power houses in as much as the discharge from the latter would interfere with the down stream approach to the locks. The passage above the locks must be made through a channel feeding three power houses and a dam and having a side pull caused by the upper and regulating dam which would make the lock approach and wharf accommodation exceedingly dangerous.

The proposed plans will completely close the channel through the rapids for free navigation. It will force all boats to pass through locks on both the downwards and upward trip. The Richelieu and Ontario Navigation Company which do a large tourist traffic, advertise the beauty of these rapids as one of their main attractions, and besides they would lose a great portion of their passengers on account of not being able to make the train connections on which they depend. The delay through locking rafts which now run the rapids is a matter of great importance to all the navigation interests.

5. Interferes with Canals.

The Georgian Bay Canal has been proposed and in time will be constructed, but now the time is right upon us when the Welland Canal must be and will be deepened to a depth of 24 feet. When Canada wants her inland waterway via the St. Lawrence deepened it ought not and must not be left to a private company to supply that cheaper and deeper channel. The Company says nothing about a Cornwall Canal to be deepened to 24 feet and what effect the dams and dykes would have in such an event, yet will a Canadian Government which is to spend thirty millions dollars deepening the Welland Canal consent to a private company getting its hands on the very throat of the St. Lawrence? If a dam is needed on any point on the St. Lawrence to improve navigation on that river or on any canal that runs out from that river, such a dam must never pass into the hands of a private company; it must be built and kept for ever in the control of the central Government which control the waterways. The interests of navigation are supreme and no interest along the St. Lawrence or in Canada will suffer by letting this stand aside until the Welland

Canal is deepened to 24 feet and the effect of such an enlargement upon our St. Lawrence shipping is seen.

6. Works a constant menace.

With all due respect to designing engineers, it is often impossible to overcome the caprice of nature or to foresee the act of some individual intent upon evil doing. The plans of the Company show the river completely closed by a series of dams and power-houses. A break in any of these or the carrying away of the proposed locks which it will be noticed are to have a single lift as the Sault Ste. Marie canal (which was carried away last year) would cause untold damage to the lower river. Even the G. T. R. station at Cornwall which is elevated 191·4 is lower than the dam. How far the resultant wave will extend is difficult to calculate, but it is doubtful if the Lakes St. Francis or St. Louis would have any influence on the onrush of water; that the town of Cornwall, the lower portion of its canal and the Soulanges canal would be carried away is quite probable, while the damage on the Lachine would be considerable. The floods caused by the breaking of the reservoir in Johnstown in 1889 or the inundations of the Mill River Valley, Mass., in 1874, would be nothing as compared to the devastation caused by the breaking away of these works on the St. Lawrence. There are several dangerous factors which would cause a break as follows:—Insufficient strength and design; movement in underlying rock (this movement is sometimes found where a break occurs as at a rapids, and is found in the wheel pit of one of the power houses at Niagara Falls); or earthquake or dynamite in the hands of some ill-advised parties (men are now spending terms in Kingston for an attempt on the Welland Canal some few years ago.)

7. Scenic Beauty.

The Company in their literature lay great stress on the wonderful sight of the new locks and the overflow dam as offsetting the beauty of the natural rapids and untrammelled nature. The trip down this unique rapids which would be sacrificed, affords a sensation which is very attractive to tourists. And it is well known that this trip is extensively advertised by navigation companies. Your Commission when considering the situation at Niagara Falls were greatly influenced by the advocates for the preservation of the scenic beauty of that waterfall. If this applies in one case should it not be a precedent in the remainder of the great waterways system?

8. District well supplied.

Although it would be a mistake not to encourage development for water powers, it would be unwise to encourage one which has no definite purpose in view. The financial world has learned by sad experience that there must be a demand for power before any large water-power can be carried with anything approaching success. It is not necessary to go to Niagara for example, but, at Massena within three miles of the Long Sault is a plant which was finished at a cost of ten million of dollars in 1901 and in 1902 was sold for five hundred thousand according to the 'Engineering News' of those dates. At the present time there is not a demand in Eastern Ontario but that can be satisfied by cheap development much nearer the consumer than the proposed development. On the contrary all the large centres are over supplied and within a radius of 150 miles (which is at the present time economical electrical transmission distance) there are, outside of any international waters, water-powers available for development purposes over two million horse-power. This district has been thoroughly investigated by the Hydro-Electric Commission of Ontario who have offered and still offer to meet all demands which could be expected of any transmission company and to supply the needs of this district at cost which is certainly more than could be expected of a company selling power for dividend purposes. There is absolutely no market for any large development of power at the Long Sault and the projectors can only hope to profit by one of two things:—

(1) By hawking the franchise through the money market of the world and obtaining millions for it on account of its enormous potentialities, or

(2) By holding the franchise till advances in electrical transmission over much greater distances than at present, in which case its value would be simply enormous.

Transmitting to New York City or electrifying the American railway lines will not benefit the Canadian people who own one-half the power in the river.

The company's engineers state that work will be started first on the United States side and the Canadian demands (which are nil at the present time) will be supplied by imported United States power. This means the building up of industries on the American side and gradually developing the Canadian side to meet these demands; just as the power companies on the Canadian side at Niagara are building up New York State where there is not such great competition for the sale of energy; but when the time comes that Canada will require this energy for her own industrial use she will find such a loud clamour from the dependent users in the United States backed by the power company (who are obtaining larger prices than could be expected in Canada) that it would be impossible to obtain any fair division in spite of all agreements made a decade before and especially when 80 per cent of the power houses are located south of the boundary line.

During the last few weeks as the press and public become better acquainted with the immensity of the undertaking and the value of the franchise which is coveted by these schemers, it becomes more and more evident that the whole Canadian people, and more particularly those bordering on the districts affected and who have not some selfish interests involved, are becoming greatly agitated and are unable to understand why influential men who formerly have stood high in the opinion of the country have allowed themselves to support and assist these promoters in trying to acquire one of Canada's greatest natural resources.

Although this is a national question and one affecting the whole of Canada yet it is those living along the river who realize more fully the huge nature of this project and apprehend with increasing alarm the destruction to property and obliteration to homes which must follow the damming of the mighty St. Lawrence.

Yours faithfully

(Signed) J. Wesley Allison, & I. Hilliard,
Counsel for Ontario,
and on behalf of Morrisburg and Williamsburg.

Mr. D. L. McCarthy, K.C.: May I say one word on behalf of the parties interested in this enterprise? If your Commission do decide do hear the Ontario Government on this point, might I ask that the hearing be adjourned until such time as we are able to be represented? As a matter of fact, Mr. Leighton McCarthy, who has had charge of this matter, left for England last week, and it may be some time before he will be able to get back. In case the Ontario Government is to be heard, I would therefore ask that in that event you postpone the hearing for sufficient time to enable him to be present.

Mr. Lynch-Staunton: Pardon me, gentlemen. If you come to the conclusion to grant my request, I suggest that you make a direction that the promoters furnish us with the material or copies of material that they have laid before the government.

Chairman Gibbons: I might say to you, Mr. Staunton, that the Commission have not dealt and are not proposing at present to deal with any particular plans. All that we were considering so far was whether it was possible, under any plans that would be approved of by both Governments and by this Commission, to erect these works at this point in the St. Lawrence river. We were forced into dealing with it, without going into the question of details, by a request with reference to a Bill before Congress. That Bill provided that the works should be permitted to be constructed under plans to be approved by both Governments, and under the provisions of certain laws in force in the United States with reference to the protection of public interests by reason of the construction of dams in navigable streams. So that under that particular reference this Commission was not asked to decide as to any particular form or plan of construction but merely to advise whether, having relation to the fact that this was a boundary stream, it was possible, consistent with the interests of navigation, to permit this work to go on. The Commission, if it reported that this was a possibility, would then doubtless report that the plans and specifications should be submitted by the Company to the Commission to be approved of by them, and also to be approved of by the representatives of both Governments. In so important a matter it was not at all likely that the plans would be even left to this Commission to decide but both governments would insist on approving of them; and that was the idea in the Bill introduced by this Company into Congress—that the two Governments should approve of the plans. So that we felt—and that is the reason we had this discussion at the previous meetings—that we ought in the meantime to hear from all the interests with regard to the initial question, which was, whether under any plans it was permissible to erect a dam at this point of the river. It is certain that so far as the details are concerned, you will be given them—I hope through this Commission; but that is another stage altogether in the carrying out of this work.

Mr. Lynch-Staunton: Would you allow me to add something then, that is just suggested to me?

Chairman Gibbons: Yes.

Mr. Lynch-Staunton: The Government I represent has come to this conclusion; that so far as they can influence it, they wish the Commission not to recommend that the power to dam the St. Lawrence river should be given to any private corporation; but that if the St. Lawrence is eventually to be dammed it shall be done by the Governments, under some arrangement made either between the State of New York and the Province of Ontario or between the United States and the Dominion of Canada; and that that dam and all the works connected with that in the generation of electric current should be absolutely and for ever controlled by the Governments and the countries and not by private individuals.

Chairman Gibbons: I think the Commission agrees with you in that—certainly that the canals should be absolutely under Government control.

Mr. Lynch-Staunton: What I mean by that is that if the Commission in their wisdom think it well so to advise, the Company take the power from it, but that all the dams and works of that description from which this power is generated should never be allowed to pass out of the control of the Governments of the United States and Canada. We think that that is of the utmost importance. It is said that there are 600,000 or 700,000 h.p. to be developed at that point. We hope and we believe that in the future not only can we light the country at night, not only can we drive its wheels, but we can heat the homes of Canada and of New York from the St. Lawrence river. It will not only be a royal highway but will be the greatest blessing and benefit to the people who live along its borders; and for that reason we think it never should be allowed to pass out of the control of these countries. We have no confidence—not speaking disparagingly of that—in the generosity of any private corporation when it gets control of such hugh monopolies as that , which amount practically to principalities; and without knowing anything more about it, on general principles we urge strongly that the Commission will never allow any person to put a proprietary foot upon any dam in the St. Lawrence river.

Public hearing closed at 3.30 p.m.

SIXTH PROGRESS REPORT OF AMERICAN SECTION.

NOVEMBER 1,1910

Being reports to the Secretary of State and the Secretary of War.

REPORT TO THE SECRETARY OF STATE.

International Waterways Commission,
Office of Chairman, American Section,
Washington, D.C., November 9, 1910.

The Honourable Secretary of State,
Washington, D.C.

Sir,—

1. The American members of the International Waterways Commission have the honour to submit the following report, covering their work under the Department of State for the period December 1, 1909, to November 1, 1910.

2. As stated in former reports, by Article IV of the treaty between the United States and Great Britain, signed April 11, 1908, the commission is authorized to ascertain and re-establish the location of that portion of the international boundary between the United States and the Dominion of Canada which passes through the Great Lakes system, beginning at its point of intersection with the St. Lawrence River near the forty-fifth parallel of latitude and extending through the St. Lawrence River and the Great Lakes and communicating waterways to the mouth of Pigeon River, at the western shore of Lake Superior. To do this properly it was found necessary to construct a series of new charts especially for the purpose.

3. The construction of the new charts is being carried on in the Buffalo office of the commission by experts from Canada and the United Staes. There are to be constructed in all 30 charts, including an index chart. In the following table is given the state of completion of the drafting upon each chart on December 1, 1909, and also on November 1, 1910, showing the progress made during the year.

Chart.	Scale.	Per cent completed.	
		Dec. 1, 1909.	Nov. 1, 1910.
1. St. Lawrence River	1·20,000	98	100
2. “	1·20,000	100	100
3. “	1·20,000	100	100
4. “	1·20,000	100	100
5. “	1·20,000	......	100
6. “	1·20,000	....	100
7. “	1·20,000	....	100
8. Eastern end Lake Ontario	1·60,000	....	....
9. Lake Ontario	1·300,000	....	....
10. Niagara River	1·20,000	....	....
11. “	1·10,000	....	15
12. “	1·20,000	....	....
13. Lake Erie	1·300,000	98	98
14. Western end Lake Erie	1·60,000	100	100
15. Detroit River	1·20,000	100	100
16. “	1·20,000	100	100
17. Lake St. Clair	1·60,000	100	100
18. St. Clair River	1·20,000	100	100
19. “	1·20,000	100	100
20. Lake Huron	1·300,000	....	....
21. North end Lake Huron	1·60,000	....	25
22. St. Marys River	1·20,000	....	100
23. “	1·20,000	....	80
24. “	1·20,000	....	95
25. “	1·10,000	....	95
26. “	1·20,000	....	80
27. Eastern end Lake Superior	1·60,000	....	70
28. Lake Superior	1·300,000	....	....
29. Pigeon Bay	1·20,000	....	....
30. Index	....	....	....

About 65 per cent of the total work of drafting upon all the charts was completed November 1, 1910.

4. In the following table is given the state of completion of the copper engraving upon each chart on December 1, 1909, and also upon November 1, 1910, showing the progress made during the year:

Chart.	Scale.	Per cent completed.	
		Dec. 1,	Nov. 1,
1. St. Lawrence River	1·20,000	20	96
2. "	1·20,000	20	98
3. "	1·20,000	10	98
4. "	1·20,000	....	98
5. "	1·20,000	....	30
6. "	1·20,000	....	15
7. "	1·20,000	....	10
8. Eastern end Lake Ontario	1·60,000	....	....
9. Lake Ontario	1·300,000	....	....
10. Niagara River	1·20,000	....	....
11. ¾	1·10,000	....	....
12. "	1·20,000	....	....
13. Lake Erie	1·300,000	95	98
14. Western end Lake Erie	1·60,000	95	98
15. Detroit River	1·20,000	80	98
16. "	1·20,000	80	98
17. Lake St. Clair	1·60,000	80	98
18. St. Clair River	1·20,000	80	98
19. "	1·20,000	80	98
20. Lake Huron	1·300,000	....	....
21. North end Lake Huron	1·60,000	....	....
22. St. Marys River	1·20,000	....	85
23. "	1·20,000	....	98
24. "	1·20,000	....	98
25. "	1·10,000	....	20
27. Eastern end Lake Superior	1·60,000	....	....
28. Lake Superior	1,300,000	....	....
29. Pigeon Bay	1·20,000	....	....
30. Index	....	....	....

About 44 per cent of the total work of engraving upon all the charts was completed November 1, 1910.

5. During the year all the field work in the survey of the upper Niagara River and about 50 per cent of the drafting work was completed. The surveys of the Canadian shore of the St. Marys River at Sault Ste. Marie, of the American shore of Whitefish Bay from Salt Point to Emerson, Mich., and of changes at West Neebish Channel, St. Marys River, were completed, and observations were made to locate the positions of all lights upon St. Marys River from Point Iroquois to Point aux Frenes.

6. Much study was given to the form and character of the monuments to be used in marking the boundary upon the ground. Manifestly it is not expedient to place these monuments upon the turning points, inasmuch as these points are all in water, where in many cases the monuments would be obstructions to navigation, and where they would often be very costly to build on account of great depth. It was decided to place them on shore, one as near as practicable to each turning point. With the range and distance of the turning point known, it will be easy to find it whenever it may be necessary to know it with precision. After careful investigation it was decided to build the monuments of concrete, in the form of the frustrum of a cone with a hemispherical top. The height above ground is to be 2 feet 6 inches, diameter at base 2 feet, diameter at top 1 foot 6 inches, radius of hemispherical top 9 inches, foundation to extend 5 feet below the surface of the ground. A copper pin is inserted in

the top to mark the point with precision. Each monument has a separate number, cast in its side at the time of fabrication. This type is to be used, except at the entrance to the lakes, where it is proposed to erect special monuments which shall constitute range marks.

7. Detachable forms of steel for molding the concrete were made from designs prepared by Mr. W. E. Wilson, secretary of the commission, and the work of placing the monuments was begun in July upon a small scale at the eastern extremity of the line near St. Regis in the St. Lawrence River. By the end of the season, when work was suspended for the winter, 35 monuments had been placed, covering the reach from St. Regis to Waddington, N.Y., a distance of approximately 32 miles. The work was experimental and resulted in demonstrating the neatness and effectiveness of the type adopted. It is proposed to organize additional parties, and to push the work with vigour during the next working season.

8. As the greater part of the data upon which the new charts are based is found in the records of the Engineer Bureau of the War Department, the commission has been constantly in correspondence with that bureau, and are desirous to acknowledge the promptness and courtesy of the Chief of Engineers, Gen. W. L. Marshall, and his successor, Gen. W. H. Bixby, in answering all its calls for information.

9. The chairman of the American section having been called upon by the State Department for an estimate of the funds required to carry on the work during the next fiscal year, submitted an estimate of $20,000 in his letter dated October 7, 1910. This action was confirmed by the other American members at their meeting October 28, 1910.

Yours, very respectfully,
O. H. ERNST,
Brig. Gen., U. S. Army, Retired,
Chairman of American Section.

GEORGE CLINTON,
Member of American Section.

E. E. HASKELL,
Member of American Section.

Attest:
W. EDWARD WILSON,
Secretary of American Section.

REPORT TO THE SECRETARY OF WAR

INTERNATIONAL WATERWAYS COMMISSION,
TORONTO, ONTARIO, October 28, 1910.

The Honourable SECRETARY OF WAR,
Washington, D. C.

SIR,—1. The American members of the International Waterways Commission have the honour to submit the following progress report covering their work under the War Department for the year ending November 1, 1910:

REGULATION OF LAKE ERIE.

2. The organic act creating the commission prescribed as one of its duties that it should 'report upon the advisability of locating a dam at the outlet of Lake Erie with a view to determining whether such dam will benefit navigation'. It so happens that the term 'dam' may apply to various works of which the character and object are very different. At the time of passing the act Congress had before it the report of the Board of Engineers upon deep waterways between the Great Lakes and Atlantic tide waters, dated June 30, 1900, in which it was recommended that the level of Lake Erie be 'regulated',—that is, that its oscillations be reduced—by means of a submerged weir in connection with a set of sluice gates placed at its outlet near the head of Niagara River. It seemed probable that this was the kind of works which Congress had in mind when using the term 'dam.' Their object would be to raise the low-water surface of the lake without raising the high-water surface. But the term 'dam' may also be applied to a submerged weir without sluice gates, the object of which would be simply to raise the level of the lake without reducing its oscillations. The low-water surface would be raised, but so would the high water to nearly an equal amount. To distinguish works of this kind from those designed to 'regulate' the lake, they may be called 'compensating' works.

3. It was evident to the commission that to make a complete study of the regulation of Lake Erie, it was necessary to make an hydraulic analysis of the general regulation of all the Great Lakes. This work was begun soon after the organization of the commission in 1905, and was not completed until last year. The conclusions then reached from these studies were that only a very moderate degree of improvement in regulation over what nature provides is practicable in any of the lakes, and that, such as it is, this improvement is obtained at the expense and to the injury of the navigable channels below. In the case of Lake Erie, it would be possible to raise the extreme low stages about 1 foot, and this in turn would raise the low-water stages of Lake St. Clair about 0·61 foot, and of Lake Huron-Michigan about 0·27 foot, all without appreciable increase in the extreme high stage. But in doing this the low-water stage of Lake Ontario would be lowered about 4½ inches, the available depth in the St. Lawrence canals would be diminished about 7·66 inches, and the city of Buffalo would suffer by increased damage from floods and from a postponement of the date of opening navigation in the spring. The question of damages to vested rights was thus introduced in a particularly intricate form. While the advantages of regulation might outweigh the disadvantages if the persons who were to benefit from the former were identical with those who were to suffer from the latter, the difference was not great enough to justify the two Governments in entering upon the vexatious question of damages. The commission therefore decided to recommend that the 'regulation' of Lake Erie be not undertaken.

4. There remained to be considered the other kind of works covered by the term 'dam,' or compensating works. The Niagara River at its extreme upper end is an important safety valve for the protection of Buffalo from the effects of storms upon Lake Erie, and should not be obstructed by a dam, but it is believed that somewhere in the river between Lake Erie and the Falls a submerged dam may be placed which will greatly benefit the navigation of the waters above without injury to those below, and with only minor damages, if any, to the adjoining lands. Without any attempt to 'regulate' Lake Erie, the general level of the lake may be raised sufficiently to compensate for the

damages heretofore inflicted by the Chicago Drainage Canal and other deteriorating influences. To determine the best site for such a dam it was necessary to make additional surveys. These were begun in July, 1909, but during the following winter it became evident that it would require many months to complete the maps and the studies required for a report. The commission therefore decided to submit to the two Governments without further delay the data which it had collected and the conclusions which it had reached concerning one branch of the subject committed to it, i. e., the 'regulation' of Lake Erie. This it did in its report dated January 8, 1910. The report was forwarded to Congress by the President, and was published as House Document No. 779, Sixty-first Congress, second session. An edition was printed also for the use of the commission, at the joint expense of the Canadian and American sections. It is the intention of the commission to submit a supplementary report to cover the subject of compensating works as soon as the necessary surveys and studies are completed. The field work of the survey and more than half of the work of constructing the maps have been completed.

LONG SAULT RAPIDS, ST. LAWRENCE RIVER.

5. By letter dated December 24, 1909, copy appended, marked 'A', the Committee on Rivers and Harbors of the House of Representatives transmitted to the commission a copy of H. R. 14531, a bill to provide for the construction of certain dams, locks, canals, and other structures in the St. Lawrence River, near Long Sault Island, for the development of power, and requested the opinion of the commission thereon. The subject of legislation to authorize power development at this place was not a new one. It first came before the commission in 1907 and has had consideration from time to time since then (see Progress Reports for 1907, 1908, and 1909). Public hearings by the full commission were held in Toronto October 24, 1907, and November 21, 1908, and at Buffalo February 26, 1909, and by the Canadian section at Montreal November 6, 1907. The letter above mentioned from the Committee on Rivers and Harbors reviving the subject was considered by the commission at its meeting in Buffalo January 8, 1910. The Canadian members desired time for further consideration and particularly time enough to hold another public hearing in Canada. They stated that the objection, mentioned in our former reports, of the Prime Minister of Canada, to consideration of the subject had been withdrawn. The desired public hearing was held at Toronto on the 8th and 9th of February, 1910, but again the Canadian members desired time for further consideration, and action was deferred until the next meeting. At a meeting held in Buffalo March 11, 1910, the subject was again considered, but the Canadian members were still not prepared to join in a report. By this time the session of Congress was so far advanced that no further delay was permissible if the report was to be of any service to the Committee on Rivers and Harbors. The American members felt compelled to express their own views, and did so in a letter dated March 11, 1910 (copy appended, marked B). Subsequently there was another public hearing at Toronto April 15, 1910, but the commission took no action, and the subject may for the present be regarded as closed.

INTERNATIONAL BOUNDARY.

6. The work of the commission in ascertaining, re-establishing, and marking the course on the ground of the portion of the international boundary which

passes through the Great Lakes system and the St. Lawrence River is described in a separate report addressed to the Honourable Secretary of State.

Yours, very respectfully,

O. H. ERNST,
Brig.-Gen., U. S. Army, Retired,
Chairman of American Section,

GEORGE CLINTON,
Member of American Section,

E. E. HASKELL,
Member of American Section.

Attest:
W. EDWARD WILSON,
Secretary of American Section.

APPENDIX A.

COMMITTEE ON RIVERS AND HARBORS,
HOUSE OF REPRESENTATIVES,
WASHINGTON, D.C., December 24, 1909.

Brig.-Gen. O. H. ERNST,
Chairman International Waterways Commission,
605 Fourteenth Street, City.

MY DEAR SIR,—Inclosed please find copy of H.R. 14531, a Bill to provide for the construction of dams, locks, canals, and other appurtenant structures in the St. Lawrence River at and near Long Sault Island, St. Lawrence County, N.Y. This committee would be glad to have the opinion of your commission on this bill.

Very respectfully, yours,
D. S. ALEXANDER,
Chairman.

(Sixty-first Congress, second session. A. R. 14531. In the House of Representatives, December 14, 1909.)

Mr. Malby introduced the following bill, which was referred to the Committee on Rivers and Harbors and ordered to be printed.

A BILL to provide for the construction of dams, locks, canals, and other appurtenant structures in the Saint Lawrence River at and near Long Sault Island, Saint Lawrence County, New York.

Be it enacted by the Senate and House of Representatives of the United States of America in Congress assembled, That the Long Sault Development Company, a corporation organized under the laws of the State of New York, its successors and assigns, be, and they hereby are, authorized to construct, maintain, and operate for water-power and other purposes a dam or dams across the Saint Lawrence River between points on the United States and Canadian shores of said river near Long Sault Island or Barnharts Island or Sheek Island, and the said islands, or any of them, and between said islands, in and across so much of the said river as lies south of the international boundary line between the United States of America and the Dominion of Canada, either independently or in connection with like works now erected or to be erected in and across so much of said river as lies to the north or Canadian side of said international boundary line, and in connection with such dams or dams, a bridge or bridges and approaches thereto, and a lock or locks, a canal or canals, and other structures appurtenant thereto: *Provided,* That such dam or dams, lock or locks, canal or canals, and other structures appurtenant thereto shall be constructed, maintained, and operated in all respects subject to and in accordance with the provisions of the act entitled 'An act to regulate the construction of dams across navigable waters,' approved June twenty-first, nineteen hundred and six: *And provided further,* That such bridge or bridges and approaches thereto shall be constructed, maintained, and operated in all respects subject to and in accordance with the provisions of the act entitled 'An act to regulate the construction of bridges over navigable waters,' approved March twenty-third, nineteen hundred and six, except that the actual construction of the works hereby authorized shall be commenced within one year and completed within fifteen years from the date of the passage of this act, or from the date of the consent of the proper authorities of the United States of America and the Dominion of Canada to the construction of said works, or of the approval of the plans and specifications and location and the accessory works therof; and this act shall not be construed as authorizing said company, its successors or assigns, to construct the said dams, canals, locks, and other works until such consent and approval shall be obtained.

APPENDIX B.

BUFFALO, N.Y., March 11, 1910.

Hon. D. S. ALEXANDER,
Chairman, Committee on Rivers and Harbors,
House of Representatives, Washington, D. C.

SIR,—The American members of the International Waterways Commission have the honour to acknowledge the receipt of your letter of Decembr 24, 1909, transmitting a copy of H. R. 14531, a Bill now before Congress, and requesting the views thereon of the International Waterways Commission. Your letter was laid before the commission at its meeting in Buffalo on the 8th of January, 1910, but no action was taken, the Canadian members desiring further time for consideration, and particularly time enough to hold a public hearing in Canada. This public hearing was held at Toronto on the 8th and 9th of February, 1910, but again the Canadian members desired time for further consideration, and action was deferred until the next meeting. At a meeting held in Buffalo to-day the subject was again considered, but the Canadian members were still not prepared to join in a report. The American members feel that if the report is to be of any use to your committee at the present session of Congress it must be submitted without further delay, and they therefore submit their own views at this time, not without hope that the full commission may be able to concur in a joint report hereafter.

The Bill authorizes the Long Sault Development Company, a corporation organized under the laws of the State of New York, to construct certain dams, locks, canals, and other structures in the St. Lawrence River near Long Sault Island. We have obtained from the company an outline of their plans. In cooperation with a Canadian corporation—the St. Lawrence River Power Company—it is proposed to construct a dam from the American shore to Long Sault Island, another dam from the foot of Long Sault Island to Barnhart Island, and another from Barnhart Island to the Canadian shore, thus damming the entire river making all of its surplus waters available for power purposes. Locks are to be introduced, and the open navigation of the rapids, which is now available only for a part of the downstream traffic, will be changed to slack-water navigation, which will be available for all traffic, whether upstream or downstream. It is entirely possible that a scheme of this kind, if carried out under proper government control, would be of great advantage to both the United States and Canada. Under proper plans the navigation of the river might be much improved, while a large amount of cheap power would be created and made available for use on either side of the boundary.

The St. Lawrence River is a great commercial highway, the importance of which is increasing with the growth of the country tributary to it. At various places the river is obstructed by rapids, as at Long Sault Island, and at these places lateral canals have been constructed by the Canadian government through which the principal traffic of the river passes, a few passenger steamers using the open river on their downstream trips. As the country has developed and as the economical size of vessels has increased, the facilities offered by these canals have become less and less adequate. A demand for improved facilities already exists and is sure to grow. Probably the best way to secure the wide and deep channels required is to canalize the open river, and incidentally this method of improvement gives an opportunity to develop an important water power. Where both banks of the river are under one jurisdiction, as is the lower St. Lawrence, the difficulties to be encountered are purely engineering difficulties. Where the river constitutes a part of the international boundary, as at Long Sault Island, there are also political difficulties.

In either case the primary object of damming the river should be the improvement of navigation. The levels of the pools and the height and location of the dams should be fixed with that purpose in view, the development of power being incidental and secondary. And it follows that the Government must have such control of the works after their completion as shall insure their permanency and their proper manipulation in the interest of navigation. Its control must be so complete that it may be doubted whether it can be secured without actual ownership.

It is in the interest of civilization that the St. Lawrence River, where it forms part of the international boundary, should not go undeveloped, either for navigation or power. If the two Governments could unite in a scheme for canalizing it at public expense, the problem would be solved in the most satisfactory way. No such scheme is before us, and it does not seem probable that the United States Government, having in view the more pressing demands upon its Treasury for the improvement of its navigable waterways, will in the near future be prepared to join in canalizing the St. Lawrence. If the St. Lawrence is to be improved within the present generation, it seems to us that it must be done either by the Canadian government alone or by the enlistment of private capital.

It is the latter alternative only that the Bill brings under discussion. We have endeavored to find a solution which is at least practicable, if not the most satisfactory.

If private capital is to be enlisted, it must be under complete government control. The difficulties in the way of such control, which arise from the international character of the stream, are considerable, but it seems to us possible to overcome them. Among the elements of government control are: (1) Legislation authorizing the construction of the works, and prescribing the conditions necessary to protect navigation and other public interests: (2) careful scrutiny of detailed plans by the executive and requirement that they conform to the conditions prescribed by the legislature; (3) supervision by the executive of the construction of the works, and the requirement that they conform to the approved plans; (4) establishment and enforcement of regulations for operating the works. It seems to us possible to secure co-operation of the two Governments in all these respects. It is, of course, impracticable for the legislatures of the two countries to act simultaneously. One must act in advance of the other; but if any law which the first may pass shall contain the proviso that it shall become operative only after the approval of the other, co-operation in legislation will be secured.

Co-operation in the approval of plans, the supervision of the construction of the works, and the establishment and enforcement of regulations for operating them can be obtained through this commission by giving it executive authority; that is, by making its advice potential to the executives of the respetcive countries.

The Bill referred to us seems to recognize the necessity of co-operation between the two Governments, but it does so in a vague way, and is much less explicit than it should be. A separate section should be introduced, worded as follows:

'Section—.This Act shall not become operative until the government of the Dominion of Canada shall signify to the Secretary of State of the United States its consent to the construction of such dam and other structures: *Provided*, that if said consent not be given within two years from the date of this act, then this act shall be null and void.'

The conditions provided in the Bill for the protection of navigation and other public interests are contained in a reference to two United States laws which apply to streams which are exclusively American. To make them applicable to the St. Lawrence the following additional provisos should be introduced:

'*And provided further*, that all plans, drawings, and maps, and all deviations therefrom and modifications therof, either before or after completion of the structures, and all conditions and stipulations which may be imposed in connection with the erection, use, and operation of the dams and works shall first be submitted to and approved by the International Waterways Commission: *And provided further*, That the construction, maintenance, regulation, and operation of such structures shall be in accordance with any agreement which may be made in reference thereto between Great Britain, acting on behalf of the Dominion of Canada, and the Secretary of State of the United States, acting on behalf of the United States, with the assent of the Secretary of War.'

Additional sections should be introduced as follows, viz:—

'Sec.—The dam or dams, and lock or locks, and other works shall be constructed under the supervision of an engineer to be designated by the Secretary of War; when completed the title to the lock on the south side of the boundary shall be conveyed to the United States, together with perpetual right of access thereto by the officers and employees of the United States over any and all parts of said dam and over any and all approaches thereto and over any and all bridges. The Long Sault Development Company shall maintain said locks, dams, bridges, and approaches and make all repairs thereon in such manner and at such time as may be directed by the Secretary of War, and in case of its failure to do so the Government of the United States may maintain said works and make repairs at the expense of the said company, which company shall re-imburse the United States therefor. Of the power generated by the works herein authorized, an amount which in the opinion of the Secretary of War shall be sufficient to operate any lock or locks which may be constructed shall be furnished free of charge to the Government of the United States.

'Sec.—.When completed the title to the dam or dams on the south side of the boundary shall be conveyed by the Long Sault Development Company to the United States, subject to perpetual right of user by the Long Sault Development Company and its successors, without payment for such use, except in case of forfeiture: *Provided*, That in case the said company shall at any time violate any of the provisions of this Act, or fail to comply with the directions of the Secretary of War of the Chief of Engineers, or with any conditions or regulations which may be imposed by the International Waterways Commission, with the approval of the Secretary of War, or with any conditions or regulations which may be made pursuant to any agreement between the United Sates and Great Britain, on behalf of the Dominion of Canada, the President of the United States may declare the said right of user forfeited, and so much of said dam or dams and their approaches, and of said bridges, as lie south of the boundary, shall thereupon become the property of the United States, free and clear of said right of user.

'Sec.—.The United States shall be entitled to use the waters impounded by said dam and works for the purpose of operating the lock or locks which may be constructed south of the boundary line, in such manner and at such times as the Secretary of War may require, and the United States shall at all times have the right to control the use of the dam or dams and the levels of the pool or pools formed thereby, to such extent as may be deemed necessary by the Secretary of War to provide proper facilities for navigation, and the withdrawal of water from such pool or pools for the purpose of generating power shall be subject to such regulations as may be made by the secretary of War, or by the International Waterways Commission, with his approval, and shall at no time be such as to impede or interfere with the safe and convenient navigation of the said river by means of steamboats or other vessels or by rafts or barges.

'Sec.—.The Long Sault Development Company, its successors and assigns, shall construct such suitable fishways at said dam or dams as may be required from time to time by the Secretary of Commerce and Labor.'

The time allowed in the Bill for completing the works—fifteen years—seems to us too great. We recommend that it be reduced to five years, and that a new section be introduced as follows, striking out all of the Bill after the eighteenth line on page 2:—

'Sec.—.The actual construction of the works herein authorized shall be begun within one year and completed within five years from the date when this act becomes operative.'

The principle that after navigation is fully provided for the surplus water available for power purposes shall be equally divided between the two countries is not mentioned in the Bill, but should find a place there. We recommend that an additional section be introduced, worded as follows:—

'Sec.—.One-half the power generated by the works herein authorized shall be delivered in Canada when needed there, and the other half shall be delivered in the United States when needed there, and the price charged shall be the same on either side of the boundary: *Provided*, That in case a market can not be found in one country for the full share thus assigned to that country, the surplus may be temporily diverted to the other country, but shall be returned to the country to which it belongs when needed there.'

Finally, a section should be added to the Bill reserving the right to alter, amend, or appeal it.

A copy of the Bill altered to conform to these views is herewith inclosed.

Yours, very respectfully,

O. H. ERNST,
Brig. Gen., U.S. Army, Retired,
Chairman, merican Section,

GEORGE CLINTON,
Member, American Section,

E. E. HASKELL,
Member, American Section.

Attest:
W. EDWARD WILSON,
Secretary, American Section.

1911

AMERICAN SECTION.

SEVENTH PROGRESS REPORT.

DECEMBER 1, 1911

Being Reports to the Secretary of State and the Secretary of War

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REPORT TO THE SECRETARY OF STATE.

International Waterways Commission,
Office of Chairman American Section,
Washington, D.C., December 8, 1911.

The Hon. Secretary of State,
Washington, D.C.

Sir,—1. The American members of the International Waterways Commission have the honour to submit the following report, covering their work under the Department of State for the year ending November 1, 1911.

2. As stated in former reports, by Article IV of the treaty between the United States and Great Britain signed April 11, 1908, the commission is authorized to ascertain and re-establish the location of that portion of the International boundary between the United States and the Dominion of Canada which passes through the Great Lakes system, beginning at its point of intersection with the St. Lawrence River near the forty-fifth parallel of latitude and extending through the St. Lawrence River and the Great Lakes and connecting waterways to the mouth of Pigeon River at the western shore of Lake Superior. To do this properly it was found necessary to construct a series of new charts especially prepared for the purpose.

3. The construction of the new charts is being carried on in the Buffalo office of the commission by experts from Canada and the United States. There are to be constructed in all 30 charts, including an index chart. In the following table is given the state of completion of the drafting on each chart on November 1, 1910, and also on November 1, 1911, showing the progress made during the year.

Chart.	Scale.	Per cent completed.	
		Nov. 1, 1910.	Nov. 1, 1911.
1. St. Lawrence River	1·20,000	100	100
2. "	1·20,000	100	100
3. "	1·20,000	100	100
4. "	1·20,000	100	100
5. "	1·20,000	100	100
6. "	1·20,000	100	100
7. "	1·20,000	100	100
8. Eastern end Lake Ontario	1·60,000	....	75
9. Lake Ontario	1·300,000	....	15
10. Niagara River	1·20,000	....	98
11. "	1·10,000	15	96
12. "	1·20,000	.. ..	90
13. Lake Erie	1,300,000	98	98
14. Western end Lake Erie	1,60,000	100	100
15. Detroit River	1·20,000	100	100
16. "	1·20,000	100	100
17. Lake St. Clair	1·60,000	100	100
18. St Clair River	1·20,000	100	100
19. "	1·20,000	100	100
20. Lake Huron	1·300,000	....	...
21. North end Lake Huron	1·60,000	25	60
22. St. Marys River	1·20,000	100	100
23. "	1·20,000	80	95
24. "	1·20,000	95	98
25. "	1·10,000	95	98
26. "	1·20,000	80	98
27. Eastern end Lake Superior	1·60,000	70	98
28. Lake Superior	1·300,000	....	20
29. Pigeon Bay	1·20,000	....	....
30. Index	....	....	......

About 81 per cent of the total work of drafting upon all the charts was completed November 1, 1911.

4. In the following table is given the state of completion of the copper engraving upon each chart upon November 1, 1910, and also upon November 1, 1911, showing the progress made during the year.

Chart.	Scale.	Per cent completed.	
		Nov. 1, 1910.	Nov. 1, 1911.
1. St. Lawrence River	1·20,000	96	98
2. "	1·20,000	98	98
3. "	1·20,000	98	98
4. "	1·20,000	98	98
5. "	1·20,000	30	98
6. "	1·20,000	15	98
7. "	1·20,000	10	98
8. Eastern end Lake Ontario	1·60,000	....	5
9. Lake Ontario	1·300,000	....	......
10. Niagara River	1·20,000	....	90
11. "	1·10,000	....	95
12. "	1·20,000	....	....
13. Lake Erie	1·300,000	98	98
14. Western end Lake Erie	1·60,000	98	98

Chart.	Scale.	Per cent completed.	
		Nov. 1, 1910.	Nov. 1, 1911.
15. Detroit River	1·20,000	98	98
16. "	1·20,000	98	98
17. Lake St. Clair	1·60,000	98	98
18. St. Clair River	1·20,000	98	98
19. "	1·20,000	98	98
20. Lake Huron	1·300,000	....	....
21. North end Lake Huron	1·60,000	....	....
22. St. Marys River	1·20,000	85	98
23. "	1·20,000	98	98
24. "	1·20,000	98	98
25. "	1·10,000	20	95
26. "	1·20,000	....	20
27. Eastern end Lake Superior	1·60,000	....	35
28. Lake Superior	1·300,000	....	....
29. Pigeon Bay	1·20,000	....	....
30. Index	....	....	....

About 67 per cent of the total work of engraving upon all the charts was completed November 1, 1911.

5. During the year special surveys were made of Hickory and Arabelle Islands and other small islands, located northeast of Wolfe Island, of a portion of the Rift between Wells and Hill Islands, of American Island and other small islands in the vicinity above Brockville, Ontario, all in the St. Lawrence River; also of False Detour Passage and portions of Drummond and Cockburn Islands, in the northern part of Lake Huron; also of Pigeon Bay, in Lake Superior.

6. For the construction of monuments three parties were organized and took the field at the beginning of the working season. In connection with the work of construction, each party conducted a triangulation survey, by which the monuments are accurately located.

7. One party took up the work in the St. Lawrence River, near Waddington, N.Y., where it was suspended last autumn, and carried it as far as the east end of Wolfe Island, a distance of about 70 miles, placing 45 monuments during the season. The triangulation survey was completed to the same point. Including the work of last year, 81 monuments have been placed in the St. Lawrence River, covering a distance of about 103 miles. About 16 miles more remain to be monumented before reaching Lake Ontario. This work will be completed next year.

8. Another party worked in the Detroit and St. Clair Rivers, and placed 58 monuments, completing that work. The triangulation system had been carried as far as St. Clair, Mich., on November 1, and it was expected that it would be completed to Lake Huron during November.

9. A third party worked in the St. Marys River and the northern end of Lake Huron. It placed 36 monuments, and completed the triangulation survey in connection therewith, which carried the work from False Detour Passage to a point immediately below St. Marys' Rapids,a distance of about 48 miles. About 27 miles more remain to be monumented before reaching Lake Superior. This work will be completed next year.

10. A party was also employed for a part of the season in the survey of Pigeon Bay, in Lake Superior. The work, consisting of a small triangulation system, the topography of the bay, and some inshore hydrography, was completed and 4 monuments were placed.

11. As the greater part of the data upon which the new charts are based is found in the records of the Engineer Bureau of the War Department, the commission has been constantly in correspondence with that bureau, and are desirous to acknowledge the promptness and courtesy of the Chief of Engineers, Gen. W. H. Bixby, in answering all its calls for information.

Yours very respectfully,

O. H. ERNST,
Brigadier General, United States Army, Retired,
Chairman of American Section.

GEORGE CLINTON,
Member of American Section,

E. E. HASKELL,
Member of American Section.

Attest:
W. EDWARD WILSON,
Secretary of American Section.

Memorandum for the Deputy Minister of Public Works covering the work of the International Waterways Commission during the Calendar Year 1911.

OFFICE OF THE CANADIAN SECTION,

OTTAWA, Dec. 31, 1911.

SIR,—During the calendar year 1911, the International Waterways Commission has held regular monthly meetings at Buffalo, N. Y., and Toronto, Ont., alternately. In the intervals between the meetings the collection and study of the data bearing upon the various questions submitted to its consideration were continued.

The Commission has declined, for lack of jurisdiction, to consider the following questions:—

1. An application from Henry Symond for diversion of water from the Welland canal for power purposes;
2. An application from the firm of Blake, Lash, Anglin & Cassels, barristers of Toronto, requesting, on behalf of the Ontario and Minnesota Power Company, Limited, the approval by the Commission of the plans of a proposed dam at Kettle Falls, on the Rainy river.

The Commission took occasion of the presentation of the above questions to its consideration to pass the following resolution at a regular meeting held in Toronto on November 3, 1911:

> "That, in the opinion of this Commission, all further work undertaken "by its members is limited to the questions which were under consideration "at the time of the appointment of the Joint International Commission, "under the Treaty of January 11, 1909, viz:
>
> "1. A final report on the advisability of constructing a dam at the "outlet of Lake Erie;
>
> "2. The re-demarcation of the International Boundary under the Treaty "of April 11, 1908."

REGULATION OF LAKE ERIE.

During the year 1911, a committee composed of Commissioners Coste and Haskell were engaged in the completion of the study of the regulation of Lake Erie. As stated in previous reports, the above investigation is being made to ascertain whether or not the level of Lake Erie will be raised by the construction of a submerged weir in the Niagara river in order to benefit navigation.

The Act of Congress of the United States, approved January 13, 1902, which requested that the Government of Great Britain be invited to join in the formation of this Commission, defined one of its duties as follows:

> "Said Commissioners shall report upon the advisability of locating a dam "at the outlet of Lake Erie with a view to determining whether said dam "will benefit navigation, and if such structure is deemed advisable shall "make recommendations to their respective Governments looking to an "agreement or treaty which shall provide for the construction of the same "and they shall make an estimate of the probable cost thereof."

This entailed the collection of an immense amount of data and several years of investigation and research.

A preliminary report upon this question has been prepared and published in Buffalo, N. Y., on January 8, 1910. See Page — .

The Commission, in brief, recommended that the construction of works designed to "raise the low water surface without raising the high water surface" should not be undertaken, principally because such a dam would injuriously affect navigation in Lake Ontario and St. Lawrence river and canals. The investigation, however, has led the Commission to think that it might be possible to place a submerged weir near the end of the Niagara rapids that would improve the appearance of the Falls, improve navigation in the Niagara river, would raise the low water level of Lake Erie, and consequently, Lakes Huron and Michigan without causing any injury to Lake Ontario or to the St. Lawrence river and canals. To determine this question, further studies, including a survey of the Niagara river, from Niagara Falls to Lake Erie, were required. The survey has been commenced last year and is now completed. Study was given to the question of locating and designing the dam; but the work is not yet completed. It is expected, however, that a final report upon the subject will be submitted during the coming year.

INTERNATIONAL BOUNDARY.

As stated in former reports, by Article IV of the Treaty between the United States and Great Britain, signed April 11, 1908, the Commission has been directed to ascertain and re-establish the location of that portion of the "International Boundary line between the United States and the Dominion of Canada which passes through the Great Lakes system beginning at its point of intersection with the St. Lawrence river near the forty-fith parallel of latitude and extending through the St. Lawrence river and the Great Lakes and connecting waterways to the mouth of Pigeon river at the western shore of Lake Superior."

During the season of 1911, from April to November, four (4) parties were sent out. The first party built forty-nine(49) monuments on the St. Lawrence river, from Morrisburg to the northeast end of Wolfe island, and carried on at the same time the triangulation necessary to fix accurately the position of these monuments on the boundary charts; the second built fifty-eight (58) monuments on the Detroit and St. Clair rivers, and carried on the necessary triangulation to locate the exact position of these monuments on the charts; the third built thirty-two (32) monuments on the St. Marys river, from Detour to Sault Ste. Marie, locating the same by triangulation; the fourth was employed for a short time in building four (4) monuments at the mouth of Pigeon river and in triangulation work also to fix the position of these monuments on the boundary charts.

The aggregate number of men employed on field work during the Spring, Summer and Fall of 1911, was thirty (30).

In addition to the field work, the work of constructing the boundary charts was proceeded with in the Buffalo office of the Commission by experts of nine (9) draughtsmen and engravers from Canada and the United States. As stated in former reports, there are to be constructed in all thirty (30), charts including an index chart.

The draughtsmen have completed last year the work of seven (7) charts of the St. Lawrence river, two (2) charts of Detroit river, two (2) charts of St Clair river, one (1) chart of the western end of Lake Erie, and one (1) chart of the St Marys river. They had also commenced draughting some of the other charts. Eighty-one per cent (81%) of the total work of draughting upon all the charts was completed by November 1, 1911.

The engravers have also done good work during last year upon charts of the St. Lawrence river, Lake Erie, Detroit river, Lake St. Clair, St. Clair river and St. Marys river.

About sixty-seven (67%) per cent of the total work of engraving upon all the charts was completed on November 1, 1911.

If the same rate of progress is made, the Commission will complete its work during the fiscal year 1913-14.

The whole of which is respectfully submitted.

THOMAS COTE,

Secretary Canadian Section.

James B. Hunter, Esq.,
Deputy Minister of Public Works,
Ottawa, Ont.

1912

AMERICAN SECTION PROGRESS REPORT.

International Waterways Commission,
Office of Chairman, American Section,
Washington, D.C., November 27, 1912.

The Secretary of War,
Washington, D.C.

Sir,—1. The Act making appropriations for sundry civil expenses of the Government, approved August 24, 1912, contained the following item, viz:

'For continuing until December thirty-first, nineteen hundred and twelve, the work of investigation and report by the International Waterways Commission authorized by section four of the river and harbour act approved June thirteenth, nineteen hundred and two, $10,000: Provided, That report as to the progress of the work be made by the American commissioners to Congress at the beginning of the next session.'

In compliance with these instructions the American commissioners have the honor to submit the following report for transmission to Congress.

2. The International Waterways Commission originated with section 4 of the act of Congress making appropriations for rivers and harbors approved June 13, 1902, which reads as follows:

> 'That the President of the United States is hereby requested to invite the Government of Great Britain to join in the formation of an international commission, to be composed of three members from the United States and three who shall represent the interests of the Dominion of Canada, whose duty it shall be to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada, including all of the waters of the lakes and rivers whose natural outlet is by the River Saint Lawrence to the Atlantic Ocean, also upon the maintenance and regulation of suitable levels, and also upon the effect upon the shores of these waters and the structures thereon, and upon the interests of navigation by reason of the diversion of these waters from or change in their natural flow; and, further, to report upon the necessary measures to regulate such diversion, and to make such recommendations for improvements and regulations as shall best subserve the interests of navigation in said waters. The said commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable shall make recommendations to their respective Governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof. The President in selecting the three members of said comt mission who shall represent the United States is authorized to appoinone officer of the Corps of Engineers of the United States Army, one civil engineer well versed in the hydraulics of the Great Lakes, and one lawyer of experience in questions of international and riparian law, and said commission shall be authorized to employ such persons as it may deem needful

in the performance of the duties hereby imposed; and for the purpose of paying the expenses and salaries of said commission the Secretary of War is authorized to expend from the amounts heretofore appropriated for the Saint Marys River at the Falls the sum of twenty thousand dollars, or so much thereof as may be necessary to pay that portion of the expenses of said commission chargeable to the United States.'

3. The invitation here authorized was duly communicated to the Government of Great Britain by the American ambassador in London, by letter dated July 15, 1902, and was accepted by letter from the British foreign office dated June 2, 1903. The American members were appointed October 2, 1903. They were Col. O. H. Ernst, Corps of Engineers, United States Army (now brigadier general, retired); Mr. George Clinton, of Buffalo, N.Y., and Prof. Gardner S. Williams, of Ithaca, N.Y. In 1905 Prof. Williams resigned and was succeeded by Mr. George Y. Wisner. Mr. Wisner died in 1906 and was succeeded by Prof. Eugene E. Haskell, of Ithaca, N.Y., dean of the civil engineering department of Cornell University. There was a delay of several years in the appointment of the Canadian members. Finally on the 10th of January, 1905, the following-named gentlemen were appointed, viz.: Mr. J. P. Mabee, K.C., Dr. W. F. King, chief astronomer of the Dominion, and Mr. Louis Coste, C.E. Subsequently, in November, 1905, Mr. Mabee was appointed judge of the supreme court of judicature for Ontario and was replaced on the commission by Mr. Geo. C. Gibbons (now Sir George C. Gibbons, K.C.), and in February, 1907, Dr. King resigned and was replaced by Mr. W. J. Stewart, chief hydrographer of the Dominion.

4. The American section held its first meeting in Washington, D.C., May 10, 1905. The written instructions which it received from the United States Government are contained in the following letter:

'Department of State,

Washington, April 15, 1905.

'Sir:—Referring to your letter of the 10th ultimo, asking as to the instructions which may be required by the American commissioners appointed under section 4 of the river and harbour act of 1902 (32 Stat. L., 373), especially in regard to a question which you state is likely to arise concerning the scope of the commission's investigation, the Canadian members appearing to be disposed to regard it as taking in all waters adjacent to the boundary line, whether part of the Great Lakes or not, I have to state as follows:

'The wording of the law will be seen by reference to the inclosed copy. The department's opinion is that the words "including all of the waters of the lakes and rivers whose natural outlet is by the river St. Lawrence to the Atlantic Ocean" are intended as a limitation on what precedes them, and that the investigation and report should cover only such waters, omitting the lower St. Lawrence itself as well as all other waters not discharging naturally through it.

'The broader interpretation given to the act by the Canadian authorities should be rejected, if for no other reason on account of the smallness of the appropriation for the support of the American section. Congress could hardly have intended to provide with a sum of $20,000 for the expenses incident to an investigation extending to the Pacific coast, and possibly embracing the Alaskan boundary as well.

'A portion of the report of the chairman of the River and Harbour Committee, when reporting the bill (copy of act herewith), treats of section

4, and would appear to limit the scope of the investigation to the Great Lakes system.

'When the ground to be covered has been defined, the law itself appears to be sufficiently detailed to serve as instructions to the American commissioners.

'It seems sufficient, therefore, at the present stage to inform you and the other members of the American section of the views held by the Department as to the scope of the investigation and report, and to request the American commissioners to assemble and organize as soon as possible after the 20th instant, at this capital, and to submit, after discussion, their own recommendations as to further procedure.

'I inclose, also, for your information copies of letters from Col. Ernst and Prof. Williams in regard to the place of meeting of the commission.

'Copies of your letter of the 10th ultimo, and of this, the department's reply, have been addressed to Col. Ernst and Prof. Williams for their guidance.'

I am, sir, your obedient servant,

F. B. Loomis,
Acting Secretary.

Geo. Clinton, Esq.,
'Commissioner of the United States,
'International Waterways Commission,
1012 Prudential Building, Buffalo, N. Y.'

In a conference with the honourable Secretary of War, it was decided by him that the work of the commission should be under the War Department. Subsequently the Secretary of War gave instructions that the Department of State be furnished with copies of all of the commissions' reports.

5. On the 25th of May, the full commission held its first meeting in Washington, D.C. A difference soon arose as to the scope of the investigation to be undertaken. The Canadian members desired to consider all international waters between the Atlantic and Pacific Oceans, and interpreted the act of Congress originating the commission to give them authority to do that, while the American members were by their instructions limited to the waters forming part of the Great Lakes system. It was decided that further proceedings be deferred until further instruction be received from the two Governments. The final result was that the instructions to the American members were left unaltered, and the Canadian members were authorized to proceed with the work of the commission within the field prescribed to the former. The full commission held its second meeting at Toronto, June 14, 1905, upon which date it may be said that the work of the commission began, although it was some months later when their offices became available.

6. Some of the rules of procedure adopted were the following: The offices of the Canadian section were to be established in Toronto and those of the American section in Buffalo. Meetings of the full commission were to be held in one or the other city as should be found most convenient, but usually alternating between the two. At meetings of the full commission held on American territory the chairman of the American section should preside, and at meetings held on Canadian territory the chairman of the Canadian section should preside. To enable all persons to appear before the commission or to address it, who might wish to do so, public notice of all meetings was to be given as long in advance as possible through the press of the principal cities of the Great Lakes and St. Lawrence system. Stenographic notes were to be taken of the proceedings

of all public meetings, but in order to insure greater freedom of discussion they were to be omitted at executive sessions. At first the intervals between the meetings were irregular, but later on it was found best to adjourn each meeting to some fixed date about one month in advance.

7. Through the courtesy of the honorable Secretary of the Treasury excellent quarters in the Federal building in Buffalo were assigned to the use of the American section, completely furnished and arranged with temporary partitions to suit its convenience in every respect. These rooms became available September 11, 1905. Subsequently a branch office was established in Washington in a room rented for the purpose. The section was fortunate enough to secure the services, as secretary, of Mr. L. C. Sabin, a hydraulic engineer of many years' experience in the service of the Government on the Great Lakes. He reported for duty August 1, 1905. He resigned one year later to accept the position of superintendent of the Sault Ste. Marie Canal and was succeeded by Mr. W. E. Wilson, an accomplished hydraulic engineer, who had also had experience in the Government service on the Great Lakes. In perfecting his organization the American section kept in view the necessity of collecting, arranging, and studying all of the complicated data bearing upon the technical subjects which it had to consider, which were mainly of an engineering character. Its staff and its offices were selected and arranged accordingly.

8. Among the questions brought to the attention of the commission at its earlier meetings beside the one specifically mentioned in the law, "the advisability of locating a dam at the outlet of Lake Erie," were the following, viz:

(*a*) The uses of the waters at Sault Ste. Marie for power purposes and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of the navigation interests.

(*b*) The uses of the waters in the Niagara River for power purposes and the regulations necessary to insure an equitable division of the waters between the two countries and the protection of Niagara Falls as a scenic spectacle.

(*c*) The alleged differences in marine regulations of the two countries with respect to signal lights, and the advisability of adopting uniform signals for both countries.*

(*d*) The diversion southward by the Minnesota Canal & Power Co., of Duluth, of certain waters in the State of Minnesota that now flow north into the Rainy River and the Lake of the Woods.

(*e*) The effect of the Chicago Drainage Canal upon the levels of Lakes Michigan, Huron, Erie, and Ontario, and upon the River St. Lawrence.

(*f*) Delimiting the international boundary on the international waterways and delineating the same on modern charts.

(*g*) The suppression or abatement of illegal fishing on the Great Lakes.

(*h*) The location and construction of common channels.

(*i*) Regulations to govern navigation in narrow channels.

(*j*) Protection of shores from damage due to deepening of channels and increased speed.

As some of these questions did not come under the jurisdiction of the commission as constituted they have not been the subject of special reports. Other questions subsequently arose from time to time, as will appear hereafter.

NIAGARA RIVER.

9. Upon taking up the subject of the Niagara River the commission found that great amounts of capital had been, and were continuing to be, invested in power works at Niagara Falls by private corporations under the authority

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*It was found, upon investigation, that no difference existed, the Canadian Government having adopted the regulations established by the United States.

of the State of New York or of the province of Ontario. Many millions of dollars had been expended in the works themselves and many millions more in the industrial enterprises to which they furnished power. In addition to the five principal corporations actually engaged in the development of water power, there were several other corporations preparing to engage in that work under franchises some of which had been granted and others of which were being sought for. The total destruction of Niagara Falls as a scenic spectacle was threatened. It seemed desirable that this movement should be checked without delay, and as the collection of all the data and the preparation of a full report would require time, the commission at its meeting of October 28, 1905, passed the following resolution, of which copies were sent to the Secretary of War of the United States and the Minister of Public Works of Canada, viz:

> '*Resolved*, That this commission recommends to the Governments of the United States and Canada that such steps as they may regard as necessary be taken to prevent any corporate rights or franchises being granted or renewed by either Federal, State, or Provincial authority for the use of the waters of the Niagara River for power or other purposes until this commission is able to collect the information necessary to enable it to report fully upon the "conditions and uses" of those waters to the respective Governments of the United States and Canada.'

10. By March, 1906, the information necessary for a report had been collected, public hearings had been held, and an original map of the locality, specially constructed for the purpose, had been prepared, when Congress passed the following joint resolution, approved March 15, 1906, viz:

> '*Resolved by the Senate and House of Representatives of the United States of America in Congress assembled*, That the members representing the United States upon the international commission created by section four of the river and harbor act of June thirteenth, nineteen hundred and two, be requested to report to Congress at an early day what action is, in their judgment, necessary and desirable to prevent the further depletion of water flowing over Niagara Falls; and the said members are also requested and directed to exert, in conjunction with the members of said commission representing the Dominion of Canada, if practicable, all possible efforts for the preservation of the said Niagara Falls in their natural condition.'

The American section accordingly submitted a report, dated March 19' 1906. It was published as Senate Document No. 242, Fifty-ninth Congress' first session. It was subsequently concurred in substantially by the Canadian section, and the joint report of the full commission, dated May 3, 1906, was published as Senate Document No. 434, Fifty-ninth Congress, first session.

11. The report of March 19 was followed by an exhaustive investigation of the subject by the Rivers and Harbors Committee of the House of Representatives, who, during several weeks, held public hearings at Washington, at which all persons interested were given an opportunity to be heard, and who sent a subcommittee to Niagara Falls, where a thorough inspection of the works was made, and where also there was a public hearing. The result was a confirmation of the report in all essential particulars.

12. An "Act for the control and regulation of the waters of Niagara River, for the preservation of Niagara Falls, and for other purposes," approved June 29, 1906, was then passed by Congress. It authorized the Secretary of War to grant permits for the diversion of water on the American side, and for the transmission of electrical power from Canada, under certain prescribed conditions and to certain prescribed limits. The total amount authorized being considerably less than the amounts applied for by the power companies, a more detailed

investigation, which should embrace particularly the commercial and financial side of the power-producing industry at Niagara Falls, became necessary to insure an equitable division of the amounts authorized. Capt. Charles W. Kutz, Corps of Engineers, United States Army, was detailed by the Secretary of War to make the investigation, his reports to be submitted to the American section for review and recommendation. Under these instructions the American section submitted two reports, dated September 29, 1906 (Appendix A), and November 15, 1906 (Appendix B), respectively. Special difficulties having arisen in granting a permit for the diversion of water from the Erie Canal, the American section, under instructions from the Secretary of War, caused a map of Lockport, N.Y., to be prepared, and new measurements of flow to be made at that place, and under date of March 5, 1907, submitted a special report with a form of permit. (Appendix C.)

13. Other reports relating to power development in the Niagara River were dated September 9, 1907, and March 3, 1908. The first was by the American section, and related to a letter from the Niagara Falls Hydraulic Power and Manufacturing Co. to the Secretary of State, in connection with the treaty then under negotiation with Great Britain. (Appendix D.) The second was by the full commission, and related to a bill to authorize the diversion of water below the Falls, which had been referred to the commission by the Rivers and Harbors Committee of the House of Representatives of the United States. (Appendix E.)

14. During the summer of 1908 the works of the Niagara Falls Power Co. were shut down on three occasions, and upon one of these occasions the works of the other power company on the American side, the Niagara Falls Hydraulic Power and Manufacturing Co., also were almost completely shut down. The commission having been notified in advance took advantage of the opportunity to observe the effect upon the river and the Falls of the diversion or non-diversion of the considerable body of water used by those companies. By its direction its American secretary installed water gauges at various points at and above the Falls and had them observed before, during, and after the shutdowns, and afterwards discussed his observations in a report. The conclusions which he reached were that the diversion of 8,000 cubic feet per second through these plants lowered the level of Niagara River at Grass Island near the intake of the Niagara Falls Power Co. about 3¼ inches; near the Ontario intake on the Canadian side about 1¼ inches; and at Prospect Point, the crest of the American Falls, about four-tenths of an inch. The observations are a valuable contribution to existing knowledge of the effect of power diversion upon the Falls.

SAULT STE. MARIE.

15. Upon taking up the subject of the uses of the waters at Sault Ste. Marie for power purposes the commission found that on either side of the rapids was a navigation canal, constructed by the United States and Canadian Governments respectively. The traffic through those canals had reached enormous proportions, far exceeding that of any other two canals in the world, and was rapidly increasing. After providing liberally for the service of these canals there remained available for power purposes a volume of water which was large, but was not large enough to provide for all of the schemes of development which had been projected. On the Canadian side a private corporation was operating one power canal and had projected another, which, together with the first, would take about half the surplus flow of the rapids. On the American side a power canal had been constructed by a private corporation, leaving the St. Marys River above the rapids, passing through the city of Sault Ste. Marie, Mich., and rejoining the river about a mile below the rapids, thus constituting a new and separate outlet to Lake Superior. The ultimate capacity of this canal was about

half the surplus flow of the rapids, though only one-quarter of its capacity was actually in use. On the American side, also, power works in the bed of the stream were in operation, using a moderate volume of water, but they were being altered and improved so as to increase their capacity, and it was not clear that their owners could not claim a legal right to half the surplus flow of the rapids. It was evident that some understanding must be reached by which there should be an equitable division of the surplus water between the two sides of the international boundary, and that until that was done further development should be reduced to a minimum. Moreover, the works affected the level of Lake Superior and the vast navigation interests dependent thereon, and it was desirable that the regulations to govern their operation should be known, so far as was then possible, in advance of their construction. The commission therefore passed at its session of October 28, 1905, the following resolution, of which copies were sent to the Secretary of War of the United States and the Minister of Public Works of Canada, viz:

> '*Resolved*, That in the opinion of this commission no further rights or privileges should be granted or conferred regarding the uses or diversions of the water flowing out of Lake Superior by either the Government of the United States or Canada, until all data and information are in the hands of the commission that may be necessary to enable it to make suggestions for regulating the excess of these waters, or that, if such rights or privileges be granted, they be subject to any regulations that may be adopted by both Governments.'

16. On the 3rd of May, 1906, the commission submitted to the two Governments a joint report upon the conditions existing at Sault Ste. Marie, in which were the following recommendations, viz:

> '(*a*) That no permit shall be granted for the use of the waters of St. Marys River, or for the erection of structures in, under, or over, or the occupation in any manner of, the said waters until plans have been submitted to the commission for its investigation and recommendation, and the use of the waters under such permit shall not be allowed except upon compliance with the rules hereinafter recommended.
>
> '(*b*) The commission further recommends that no grants, permits, or concessions should be made which directly or by operation of law may in any manner affect the right of the United States or of Canada to control the bed of the St. Marys River below high-water mark, and especially that none should be made which, legally, or equitably, may be the means of adding to the expense of acquiring lands or rights for the purpose of making improvements in aid of navigation, or which may give an equitable right to compensation in case of the removal of structures in said river.
>
> '(*c*) That steps be taken to increase the lockage facilities at Sault Ste. Marie without unnecessary delay.
>
> '(*d*) That the Governments of the United States and Canada reserve all water necessary for navigation purposes at present, or in the future, and the surplus shall be divided equally between the two countries for power purposes.
>
> '(*e*) As the commission regards the interests of the United States and Canada in the preservation of the lake levels and in the improvement of the channels and the conservation of the water supply for purposes of navigation as identical and as incapable of efficient protection without joint and harmonious action on the part of the two Governments, it recommends that the rules hereinafter set forth be adopted and that a joint commission be created to supervise their enforcement, or that such powers be vested in the existing International Waterways Commission, subject to such restrictions and reservations as may be deemed advisable.'

The report was transmitted by the Secretary of War to the Secretary of State with the following indorsement, dated May 14, 1906, viz:

> 'Respectfully referred to the Secretary of State with a request that after the report be read it be forwarded to the President as a basis for negotiations looking to the adoption of a treaty carrying into effect the recommendations of the International Waterways Commission, the report of which is approved so far as this department in concerned.'

Embodied in the report were a series of rules and regulations to govern the use of water at the Sault. They were based upon the regulations already established for the American side by the Secretary of War of the United States, but were extended in their application, and, like them, they recognized the following principles as fundamental: (1) Levels must be maintained; (2) navigation must be protected; (3) the public must reserve the right to use any portion or all of the natural flow in the future; (4) the use of the water is not granted to the power companies in any fixed quantity or for any fixed length of time, but the Government may enter upon the property and shut off the flow in whole or in part at any time to the extent necessary to maintain water levels. The enforcement of these rules involved the creation of a permanent international commission, and it was not until the creation of the International Joint Commission by the treaty between the United States and Great Britain, dated January 11, 1909, that it became practicable to put them in force. At the same time the creation of that commission relieved this commission of all further consideration of the subject. A full copy of the report of May 3, 1906, is hereto appended. (Appendix F.)

MINNESOTA CANAL AND POWER CO.

17. The Minnesota Canal & Power Co., a corporation organized under the laws of Minnesota, proposed to construct reservoirs in the Birch Lake Basin in Minnesota, in which water was to be stored and from which it was to be released as needed and conducted by artificial and natural channels southward to Duluth, where it was to be employed in generating electrical power. The natural drainage of the Birch Lake Basin is northward into Rainy River, Lake-of-the-Woods, Winnipeg River, Winnipeg Lake, and finally into Hudson Bay, the water thus forming a part of the international boundary and finally entering territory which is exclusively Canadian. The company applied to the Department of the Interior for permission to use certain public lands by flowage and otherwise and to the War Department for approval of certain structures designed to impound the water. Opposition to the scheme was offered by citizens of Canada through the British ambassador at Washington, and the Secretary of State by letter to the Secretary of War, dated May 14, 1906, requested that the matter be referred to this commission for an expression of its views. On the 15th of November, 1906, the commsision rendered a joint report to the two Governments, which closed with the following recommendations, viz:

> '(*a*) The commission would therefore recommend that the permit applied for be not granted without the concurrence of the Canadian Government.
>
> '(*b*) As questions involving the same principles and difficulties liable to create friction, hostile feelings, and reprisals are liable to arise between the two countries affecting waters on or crossing the boundary line the commission would recommend that a treaty be entered into which shall settle the rules and principles upon which all such questions may be peacefully and satisfactorily determined as they arise.

> '(*c*) The commission would recommend that any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be: Use for necessary domestic and sanitary purposes: service of locks used for navigation purposes; the right to navigate.
>
> '(*d*) The commission would also respectfully suggest that the treaty should prohibit the permanent diversion of navigable streams which cross the international boundary or which form a part thereof, except upon adjustment of the rights of all parties concerned by a permanent commission and with its consent.'

A copy of the report is hereto appended. (Appendix G.)

RAINY RIVER AND RIVER ST. JOHN.

18. On the 2nd day of May, 1907, the Canadian Government referred to the commission certain documents relating to the Rainy River and on the 9th of May certain other documents relating to the River St. John. Neither of these rivers being tributary to the Great Lakes and St. Lawrence system, neither of them came within the limits prescribed to the American members under the instructions which they received in 1905. In deference to the Canadian Government, however, the question of jurisdiction was submitted for the consideration of higher authority by letter to the Secretary of War, dated November 6, 1907. The previous instruction weres not altered, and the questions concerning these rivers were not considered.

RICHELIEU RIVER.

19. The Richelieu River connects Lake Champlain in American territory with the St. Lawrence River in Canadian territory. The International Development Co., a corporation organized under the laws of Canada and also under the laws of New Jersey, proposed to deepen the Richelieu River and regulate its flow so that there should be a uniform discharge of 9,000 cubic feet per second throughout the year. For this purpose it proposed to use Lake Champlain as a reservoir, in which surplus water was to be stored during the wet season and from which it was to be released during the low-water period. The works were located in Canadian waters, but would have an important effect upon American waters, including Lake Champlain. Under date of November 2, 1906, the company made application to the War Department of the United States for permission to construct the works, which application was referred by the Secretary of War to the chairman of the American section by indorsement of November 6, 1906, and was by him laid before the commission. The commisssion found that a uniform flow of 9,000 cubic feet per second could not be maintained at all seasons and in all years without giving to Lake Champlain a range between the extreme high and extreme low water which it deemed inadmissible, but that it would be possible to plan works which would not injuriously affect Lake Champlain and would materially improve the conditions of flow in the Richelieu River. Under date of November 15, 1906, it submitted a joint report to the two Governments (Appendix H), from which the following is an extract, viz:

> 'As Lake Champlain is wholly within the territory of the United States,and the proposed works are wholly within Canadian territory, the international questions raised are of some moment. It is in our opinion not desirable that either nation should obstruct the natural flow of streams

crossing the international boundary to the injury of public or private rights in the other. It is manifest, therefore, that the applicants should furnish conclusive evidence that private rights in the States of New York and Vermont adjoining Lake Champlain will not be injuriously affected by the alteration of the lake level as proposed, and that as the Secretary of War of the United States has control of the interests of navigation on Lake Champlain, the said work should not be undertaken without his permission, and should be operated under such regulation as he may direct, with a view to the maintenance of the level of the said lake as the interests of navigation thereon may require. It would be possible to plan works adapted to the conditions, and in our opinion such works should be permitted, provided they do not interfere with private interests in the United States and meet with the approval of the Secretary of War as suggested. We respectfully submit that in any treaty to be had between the two nations in relation to the use of International waters the principles above suggested should have consideration. We would further suggest that the applicant's Canadian act of incorporation should be amended, so as to provide that the maintenance of the works sought to be erected shall be conditional at all times upon compliance with all regulations imposed by the Secretary of War of the United States of America from time to time for the preservation of the levels of Lake Champlain.

20. Under the direction of the Department of Public Works of Canada, a report was prepared in 1902 upon the subject of damage by overflow of the Richelieu River and a plan was submitted for correcting the evil. At its session of 1906, the Canadian Parliament appropriated $10,000 for beginning the works proposed. The latter were to be entirely within Canadian territory, but inasmuch as they might affect the interests of the United States or of its citizens upon Lake Champlain, the Canadian Government before beginning the work referred the matter to the International Waterways Commission. The matter was considered by the commission at its session of October 24, 1907, and the following resolution was passed, of which copies were sent to the Secretary of War of the United States and the Minister of Public Works of Canada, viz:

> 'Whereas certain valuable lands in the valley of the Richelieu River, the outlet of Lake Champlain, are subject to damage by overflow; and
>
> 'Whereas a plan for the reclamation of said lands, submitted by Resident Engineer J. B. Michaud, April 7, 1902, to the Canadian Government, was referred by that Government to the International Waterways Commission under date of May 6, 1907; and
>
> 'Whereas the international question involved relates only to the effect of the proposed works upon the interests of the United States or of its citizens upon Lake Champlain; and
>
> 'Whereas the average level of Lake Champlain is 96·1 feet above tide water, and the monthly mean level during floods is about 100,
>
> '*Resolved*, That it is the opinion of the International Waterways Commission that the works proposed can be constructed without injury to the interests of the United States or its citizens upon Lake Champlain, provided a movable dam be constructed at St. Johns, and so operated that the flood waters of Lake Champlain shall be allowed to rise to a monthly mean level of 97 and the level of the lake shall thereafter be maintained at or above 95.

CHICAGO DRAINAGE CANAL.

21. On the 4th of January, 1907, the full commission submitted to the two Governments a report upon the Chicago Drainage Canal, which closed with the following summary and recommendations:

Summary.

'(*a*) Chicago obtains its water supply from Lake Michigan, and to avoid polluting it must either dispose of its sewage otherwise than in the lake or place its intakes for water at a great distance from the city.

'(*b*) The topography of the country favors the discharge of the sewage into the Des Plaines River, a tributary of the Mississippi, through two depressions in the divide which separates that river from Lake Michigan.

'(*c*) The slope on the lake side of the divide is drained by two streams, the Chicago River and the Calumet River, into which the sewers of the city empty. By a cut through the northerly depression of the flow of the Chicago River has been reversed and diverted into the Des Plaines River instead of into Lake Michigan, and by a cut through the southerly depression the same process can be applied to the Calumet River.

'(*d*) To make this reversal effective the channels must be large enough to take all the water which falls upon the respective drainage areas during the most violent rain storms. This amount is estimated at 10,000 cubic feet per second for the Chicago River and 15,700 cubic feet per second for the Calumet River.

'(*e*) The city of Chicago was originally built upon the Chicago River, and that stream now drains the richest and most populous part of the city. It is now spreading over the Calumet region.

'(*f*) In 1889 the plan of diverting the Chicago River into the valley of the Des Plaines was definitely adopted and the Chicago Drainage Canal was undertaken. It was designed to carry 10,000 cubic feet per second. Though not entirely completed, it has been in use since January, 1900. The amount expended upon the canal and accessory work is about $41,000,000.

'(*g*) The Illinois law which authorized the canal required a flow of 333 cubic feet per second for each 100,000 of population in order to render the sewage inoffensive. This amount of dilution is probably not excessive. It is reasonable to expect a population in a future not remote of five or six millions or more, involving the diversion by this standard of some 20,000 cubic feet per second. The Chicago River with its 10,000 cubic feet provides for a population of 3,000,000. The present population of the city is about 2,000,000.

'(*h*) It is now proposed to apply to the Calumet River a treatment similar to that applied to the Chicago River, viz., to reverse its flow, so that instead of discharging into Lake Michigan it shall discharge into the Des Plaines, but for a part of the new route it must follow the drainage canal already excavated for the Chicago River.

'(*i*) Although the Chicago Drainage Canal was designed to carry 10,000 cubic feet per second, it is found to have, in its completed rock portion, an actual capacity of 14,000 cubic feet. This additional capacity fixes the amount which it is proposed to divert from the Calumet at 4,000 cubic feet per second. Any greater amount from the Calumet will overtax the drainage canal at the expense of the richest part of Chicago and for the benefit of a suburban part.

'(*k*) The diversion of only 4,000 cubic feet will not be effective at all times, since a much larger amount must be diverted from the Calumet during heavy rainstorms if the lake is to be protected. Moreover, it provides for a population not exceeding 1,200,000, which number will probably be exceeded at a date not far distant.

'(*l*) The large channels necessary to provide for the contingencies of rainstorms are capable of discharging a volume of water largely in excess of sanitary requirements during the greater part of the year, but the development of water power creates the demand that they be employed to their full capacity throughout the year.

'(*m*) The diversion of large bodies of water from Lake Michigan for supplying the drainage canal has not been authorized by Congress, but there appears to be a tacit general agreement that no objection will be made to the diversion of 10,000 cubic feet per second, as originally planned.

'(*n*) The diversion of 10,000 cubic feet per second will lower the levels of Lake Michigan-Huron, Lake St. Clair, Lake Erie, Lake Ontario, and the St. Lawrence River, besides the important connecting channels, the Detroit and St. Clair Rivers, by amounts varying from 4¼ to 6¼ inches for the different waters, and the diversion of 14,000 cubic feet will lower them from 6 to 8½ inches. The diversion of 20,000 cubic feet will lower Lake Michigan-Huron about 13 inches and Lake Erie about 11 inches.

'(*o*) The lake traffic which passed through the Detroit River in 1905 was about 58,000,000 tons, valued at about $615,000,000. It is increasing annually with marvellous rapidity. The records for the year 1906, so far as they are made up, indicate that the number of tons which passed through the Detroit River in 1906 exceeded 65,000,000, valued at $690,000,000. The lowering of the water surface has every injurious effect upon this traffic and upon that of the Welland and St. Lawrence Canals. Chicago being one of the principal lake ports, there will be very few communities which will feel the injury more than she will.

'(*p*) The cost of restoring the depth in the harbours of the Great Lakes and the channels between the lakes is estimated at $10,000,000, and of restoring it in the Welland and St. Lawrence Canals at $2,500,000. This expenditure would not prevent very serious annoyance to the navigation interests during the execution of the remedial works, which would occupy several years. In Lake St. Clair, navigation of the open lake would be replaced by that of an artificial channel or canal with submerged banks.

'(*q*) The extension to the Calumet region of the method of sewage disposal already applied to the Chicago River is not necessary to preserve the health of Chicago, there being other and better methods available for the Calumet region. The final cost of these methods is somewhat greater than that of the one proposed, but the works can be developed as the population increases, and only a part of their cost need be incurred at present, while their greater efficiency justifies the increase of final cost.

'(*r*) The diversion of 10,000 cubic feet of water per second at Chicago will render practicable a waterway to the Mississippi River 14 feet deep. Any greater depth must be obtained by the abstraction of more water from Lake Michigan and at the expense of the navigation interests of the Great Lakes and of the St. Lawrence Valley.

'(*s*) The effect upon Niagara Falls of diverting water at Chicago is of secondary importance when considering the health of a great city and the navigation interests of the Great Lakes and of the St. Lawrence Valley, but it is proper to note that the volume of the Falls will be diminished by the full amount diverted at Chicago.

Recommendations.

'(*t*) The waters of Lake Michigan in the United States, the waters of Georgian Bay in Canada, and the waters of Lake Superior, partly in the United States and partly in Canada, all form sources of supply of the Great Lakes system, finding their way by the St. Lawrence to the sea. All are interdependent, and there can be no diversion from any of them without injury to the whole system. By Article XXVI of the treaty of 1871, it is provided that "navigation of the River St. Lawrence, ascending and descending from the forty-fifth parallel of north latitude, where it ceases to form the boundary between the two countries, from, to, and into the sea, shall forever remain free and open for the purposes of commerce to the citizens of the United States, subject to any laws and regulations of Great Britain, or of the Dominion of Canada, not inconsistent with such privileges of free navigation." It is desirable that in any treaty arrangement the waters of Lake Michigan, Georgian Bay, and all other waters forming part of the Great Lakes system should be declared to be "forever free and open for the purposes of commerce" to the citizens of the United States and the subjects of His Britannic Majesty, subject to any laws or regulations of either country not inconsistent with such privilege of free navigation.

'(*u*) The preservation of the levels of the Great Lakes is imperative. The interest of navigation in these waters is paramount, subject only to the right of use for domestic purposes, in which term is included necessary sanitary purposes. In our report of November 15, 1906, upon the application of the Minnesota Canal and Power Company to divert certain waters in Minnesota, we recommended among other things:

' "That any treaty which may be entered into should define the uses to which international waters may be put by either country without the necessity of adjustment in each instance, and would respectfully suggest that such uses should be declared to be—

' "Uses for necessary domestic and sanitary purposes.
' "Service of locks for navigation purposes.
' "The right to navigate."

'It is our opinion that so far as international action is concerned a treaty provision of that kind is all that is required in this case. We accordingly renew our recommendation of November 15, 1906, just quoted.

'(*v*) A careful consideration of all the circumstances leads us to the conclusion that the diversion of 10,000 cubic feet per second through the Chicago River will, with proper treatment of the sewage from areas now sparsely occupied provide for all the population which will ever be tributary to that river, and that the amount named will therefore suffice for the sanitary purposes of the city for all time. Incidentally, it will provide for the largest navigable waterway from Lake Michigan to the Mississippi River which has been considered by Congress.

'We therefore recommend that the Government of the United States prohibit the diversion of more than 10,000 cubic feet per second for the Chicago Drainage Canal.'

Two editions of this report were printed as a War Department document, and were distributed to all persons applying for them. A copy is hereto appended. (Appendix I.)

INTERNATIONAL BOUNDARY IN LAKE ERIE.

22. In the month of August, 1906, a large number of nets were placed in Lake Erie by the Keystone Fish Co., of Erie, Pa., near the middle of the lake, but on what they claimed was the American side of the boundary. Most of these nets were promptly seized and confiscated by the Canadian vessel *Vigilant*. The commander of the *Vigilant* then proposed to the American fishermen to show them the boundary, and aid them in marking it with buoys so that they might always remain on their own side of the line if they desired to do so. The

proposal was forwarded to the Secretary of State and by him to the Secretary of War, under date of September 5, 1906, with the request that it—

> 'be referred to the International Waterways Commission with the inquiry whether it is known that the American and Canadian charts of the locality agree as to the distance to be logged from the gas buoy at Erie to the boundary line on the usual fishing grounds.'

23. The commission having collected the various official charts upon which the boundary in Lake Erie is marked, proceeded to reduce them to the same system of projection and the same scale in order to compare them. It was found that the boundary as laid down on the United States hydrographic chart differed widely from that on the British Admiralty chart. They both derived their authority from the Treaty of Ghent. The map on file with the treaty was also reduced to the same system of projection and the same scale as the others, and having been compared with the accurate modern charts of the United States Lake Survey, was found to be very far from correct. It was so inaccurate that no two persons would probably transfer the boundary line marked thereon to a modern chart in the same way, and was therefore worthless for its purpose. The only guide for the location of the boundary line in Lake Erie, except at the eastern and western extremities, is in the expression in the text of the treaty, "through the middle of said lake." Under that description a variety of lines may be laid down.

24. Under date of January 4, 1907, the commission submitted to the two Governments a report which closed with the following conclusions and recommendations, viz.

> 'The commission therefore concludes:
>
> '(*a*) That the international boundary line on Lake Erie can not be ascertained with any accuracy from existing data.
>
> '(*b*) That the American and Canadian charts of Lake Erie, namely the hydrographic and British Admiralty charts, do not agree as to the distance to be logged from the gas buoy at Erie to the boundary line on the usual fishing grounds.
>
> '(*a*) That the entire boundary line from the point where the forty-fifth parallel of north latitude meets the middle of the St. Lawrence River, through that river, the Great Lakes and connecting waters, in accordance with the true intent and meaning of the treaties of 1783, 1814, and 1842, be located to accord as nearly as possible with the lines fixed by the commissioners appointed under the Treaty of Ghent and the treaty of 1842, to be delineated upon modern charts, and be so described by reference and fixed monuments, where necessary, that it can in the future be relocated at any given point by survey.
>
> '(*b*) That the location, delineation on modern charts, and monumenting of the boundary line proceed under the direction of this commission or another international commission to be appointed, and that when it is located laid down on modern charts and monumented, it be finally fixed and determined by treaty accordingly.
>
> '(*c*) That this commission be authorized to locate, lay down upon a modern chart, and monument the boundary line through Lake Erie.'

A copy of the report is hereto appended. (Appendix K.) The further connection of this commission with the boundary has been of an executive character under a special provision of the treaty between the United States and Great Britain dated April 11, 1908. It will be described farther on.

BUFFALO INLET PIER.

25. At its session in Buffalo on the 26th of June, 1906, representatives of the city appeared before the commission and requested its approval of the location of a new inlet pier for the city waterworks, which it was desired to place in the international waters on the Canadian side of the boundary. Although the question had not been regularly brought before it by higher authority, the commission thought it proper, with a view to avoiding delay, to pass the following resolution, viz:

> 'That in the opinion of the International Waterways Commission, the tunnel and inlet pier proposed to be constructed in Lake Erie by the city of Buffalo for the purpose of furnishing a pure-water supply to the city, can be built without injury to navigation or other public interests, and it is recommended that permits for the construction of these works be granted, with the proviso that the inlet pier be kept properly lighted at night at the expense of the city.'

DETROIT RIVER.

26. The plans of the Detroit River Tunnel Co. for the construction of a tunnel under the Detroit River having been referred to the commission, it passed, at its session of March 7, 1906, at Toronto, the following resolution, viz:

> 'That the International Waterways Commission approve of the plans of the construction of a tunnel under the Detroit River prepared by the Detroit River Tunnel Co. and submitted to the commission by the Chief of Engineers of the United States Army under date of February 13, 1906, and by the Minister of Marine and Fisheries for Canada under date of November 16, 1905, the construction to be carried on on the American side under the regulations contained in the report of the Board of Engineers of the United States Army of date January 26, 1906, and that the same be carried on the Canadian side under regulations to be fixed by the Minister of Public Works and the Minister of Marine and Fisheries.'

27. On the 2nd of June, 1909, a letter was addressed to Lieut. Col. C. McD. Townsend, Corps of Engineers, United States Army, the officer in charge of the channel improvements in the Detroit River, by Mr. H. J. Lamb, engineer in charge, Department of Public Works, Canada, inquiring by what authority the United States was depositing material in Canadian waters in the construction of the Livingstone Channel, Detroit River. This letter was forwarded by Lieut. Col. Townsend, with his letter of June 3, to the Chief of Engineers, and by request of the latter was referred to the International Waterways Commission by the Acting Secretary of War, by indorsement dated June 16, 1909. At its meeting in Buffalo, July 14, 1909, the commission adopted the following resolution, viz:

> 'Whereas the enlargement of the navigable channel in the Detroit River, now being made by the United States Government, west of Bois Blanc Island, is of great benefit to the navigation interests of Canada as well as of the United States; and
>
> 'Whereas the excavation for said channel and the dumping grounds are partly in Canadian waters; and
>
> 'Whereas the consent of the Canadian Government to such use of it waters has not been given;

> '*Resolved*, That in the opinion of the commission application should be made without delay to the Canadian Government by the United States Government for formal permission to excavate the channel where that work is now progressing, and that such application, when received by the Canadian Government, should be granted, provision being made that the dumping grounds in Canadian waters should be located under the direction of the Minister of Public Works of Canada.'

The matter was then brought to the attention of the Department of State and by that department to the attention of his excellency the British ambassador at Washington. The desired permission was granted by the Canadian Government upon the condition named in the resolution that " the dumping grounds in Canadian waters be located under the direction of the Minister of Public Works of Canada," and with the proviso " that such permission is given without prejudice to the possessory rights of Canada as defined by the maps and declarations of the commissioner under the Treaty of Ghent, made at Utica on the 19th of June, 1822, and provided also that the dumping of material should not prove in any way a detriment to the safe navigation of the Detroit River." Notice of this action was sent to the Department of State by the British ambassador in his letter of September 17, 1909.

ST. LAWRENCE RIVER.

28. Under date of May 28, 1906, Mr. Smith L. Dawley, of Ogdensburg, N.Y., addressed a letter to the Secretary of War, applying for permission to construct dykes, retaining walls, and such other structures in the St. Lawrence River near Long Sault Island as should be necessary to create an "attractive summer resort with navigable approaches thereto, and the development of a water-power." By indorsement dated June 2, 1906, the paper was referred to the commission. On the 4th of January, 1907, the commission adopted the following resolution, of which a copy was forwarded to each Government, viz:

> 'Whereas Mr. Smith L. Dawley, of Ogdensburg, N.Y., submitted to the honourable Secretary of War of the United States, under date of May 28, 1906, an application for permission to construct at Long Sault Island, in the town of Massena, St. Lawrence County, N.Y., dikes, retaining walls, and such other structures as might be necessary to create "an attractive summer resort with navigable approaches thereto, and the development of a water-power, entirely in that portion of the St. Lawrence River that is within the United States," which application was referred to the International Waterways Commission by indorsement of the Secretary of War, dated June 2, 1906; and
>
> 'Whereas the application did not furnish information sufficient to justify a recommendation in the matter, and the efforts of the commission to obtain such information from Mr. Dawley have thus far been without success; and
>
> 'Whereas the commission now learns that Mr. Dawley has transferred his rights at Long Sault Island to the Pittsburgh Reduction Co., and it is the opinion of the commission that if any permit for the construction of works at this place is to be granted it should be dealt with upon a direct application from the beneficiary; therefore be it
>
> '*Resolved*, That the International Waterways Commission recommend to the honorable Secretary of War of the United States that the application of Mr. Smith L. Dawley be denied.'

29. Under date of April 4, 1906, the Minister of Public Works of Canada referred to the commission a letter addressed to him by the Calvin Co. (Ltd.), a Canadian corporation protesting against the closure by a dam of the south channel at Long Sault Island, which it understood was contemplated by the Massena Water Power Co., an American corporation. It was found that the latter company had taken no steps to procure the necessary authority from the United States Government.

30. On the 18th of December, 1908, the Canadian Department of Public Works referred to the commission an application of the Cedar Rapids Manufacturing & Power Co. to the Canadian Government for permission to build works in the St. Lawrence Rver at Cedars, in the county of Soulanges, for the purpose of developing electric power. At this place both banks of the St. Lawrence River are Canadian territory, but power works in the bed of the stream affect the navigation interests of the entire river. On the 13th of April, 1909, the commission submitted a report upon the subject to the Minister of Public Works of Canada, of which copies were sent to the Secretary of State and Secretary of War of the United States. A copy of this report is hereto appended. (Appendix L.)

31. By letter dated December 24, 1909, the Committee on Rivers and Harbours of the House of Representatives of the United States transmitted to the commission a copy of a bill to provide for the construction of certain dams, locks, canals, and other structures in the St. Lawrence River near Long Sault Island, for the development of power, and requested the opinion of the commission thereon. The subject of legislation to authorize power development at this place was not a new one. A bill of similar tenor had been referred by the Secretary of War to the commission in 1907, and was the subject of public hearings April 18 and again October 24 of that year, but action was deferred under instruction from the Prime Minister of Canada to the Canadian section, to the effect that the Minister of Railways and Canals had the matter under investigation, and that it would be inadvisable for the commission to deal with the matter until the investigation was completed. The subject received consideration from time to time in 1908 and 1909, public hearings being held in Toronto, November 21, 1908, and in Buffalo, February 26, 1909, but the Canadian members were not ready to join in a report, and on our side it was understood that the plans for the proposed works were not entirely perfected and that legislation would not probably be enacted within the near future. The letter of December 24, 1909, above mentioned, from the Committee on Rivers and Harbors reviving the subject was considered by the commission at its meeting in Buffalo, January 8, 1910. The Canadian members desired time for further consideration and particularly time enough to hold another public hearing in Canada. They stated that the objection of the Prime Minister of Canada to consideration of the subject had been withdrawn. The desired public hearing was held at Toronto on the 8th and 9th of February, 1910, but again the Canadian members desired time for further consideration, and action was deferred until the next meeting. At a meeting held in Buffalo, March 11, 1910, the subject was again considered, but the Canadian members were still not prepared to join in a report. By this time the session of Congress was so far advanced that no further delay was permissible if the report was to be of any service to the Committee on Rivers and Harbors. The American members felt compelled to express their own views, and did so in a letter dated March 11, 1910, (Appendix M.) Subsequently there was another public hearing at Toronto, April 15, 1910, but the commission took no action.

DAM AT THE OUTLET OF LAKE ERIE.

32. The organic act creating the commission prescribed as one of its duties that it should "report upon the advisability of locating a dam at the outlet of Lake Erie with a view to determining whether such dam will benefit navigation." It so happens that the term "dam" may apply to various works of which the character and object are very different. At the time of passing the act Congress had before it the report of the board of engineers upon deep waterways between the Great Lakes and Atlantic tidewaters, dated June 30, 1900, in which it was recommended that the level of Lake Erie be "regulated"—that is, that its oscillations be reduced—by means of a submerged weir in connection with a set of sluice gates placed at its outlet near the head of Niagara river. It seemed probable that this was the kind of works which Congress had in mind when using the term "dam." Their object would be to raise the low-water surface of the lake without raising the high-water surface. But the term "dam" may also be applied to a submerged weir without sluice gates, the object of which would be simply to raise the level of the lake without reducing its oscillations. The low-water surface would be raised, but so would the high-water to nearly an equal amount. To distinguish works of this kind from those designed to "regulate" the lake, they may be called "compensating works."

33. The Great Lakes, with their connecting channels, constitute the most important system of inland navigation in the world. The traffic which passed through Detroit River, its busiest link, in 1907, amounted to 71,226,895 tons, valued at about $700,000,000 (the traffic of the most important river in Europe, the Rhine, was, in 1905, about 4,000,000 tons). About 80 per cent of this traffic is carried in large freight carriers which are loaded down to the greatest draft that can be carried into the harbours or through the channels between the lakes, but could be loaded much deeper if the depth of water permitted. Some of the larger of these vessels carry an additional load of 85 tons for each inch of additional draft. Every inch added to the available depth of water would therefore be of material benefit to commerce.

34. The Great Lakes constitute a series of enormous natural reservoirs, each of which serves to regulate the flow in the river constituting its outlet and to maintain the lake below. They are interdependent. The study of one, to be complete, must include the study of all. The total area drained by them is about 287688 square miles, an area considerably larger than the German Empire. Of this total about one-third is occupied by the lakes themselves—that is devoted to reservoir purposes The result is a uniformity of level and a uniformity of flow which are truly wonderful—a perfection of regulation which no work of man ever did or ever will approach. The question propounded was: Could he add to any important extent to the degree of regulation which nature provided? Enormous forces were to be dealt with, and the results were to be measured in inches. The subject was therefore as difficult as it was important.

35. Soon after the organization of the commission, a committee of two of its engineer members was appointed to collect all of the available data and to make a hydraulic analysis of the general regulation of all the lakes. It was well known at the outset that this would be a long and laborious task, but it proved to be more so than was expected, and the death of a member of the committee, Mr. Wisner, in 1906, was the cause of considerable delay. All existing records of water-level observations and discharge measurements made since 1860 were collected, analysed, tabulated, and studied. By the end of 1909 the commission was able from these studies to form an opinion as to the first kind of works covered by the term "dam"; that is, regulating works. The conclusions then reached were that only a very moderate degree of improvement in regulation over what nature provides is practicable in any of the lakes, and

that such as it is, this improvement is obtained at the expense and to the injury of the navigable channels below. In the case of Lake Erie, it would be possible to raise the extreme low-water stages about 1 foot, and this in turn would raise the low-water stages of Lake St. Clair about 0·61 foot, and of Lake Huron-Michigan about 0·27 foot, all without appreciable increase in the extreme high stage. But in doing this the low-water stage of Lake Ontario would be lowered about 4½ inches, the available depth in the St. Lawrence canals would be diminished about 7⅔ inches, and the city of Buffalo would suffer by increased damage from floods and from a postponement of the date of opening navigation in the spring. The question of damage to vested rights was thus introduced in a particularly intricate form.

While the advantages of regulation might outweigh the disadvantages if the persons who were to benefit from the former were identical with those who were to suffer from the latter, the difference was not great enough to justify the two Governments in entering upon the vexatious question of damages. The commission therefore decided to recommend that the "regulation" of Lake Erie be not undertaken and to proceed to the consideration of the other kind of works covered by the term "dam," or compensating works. As this would require surveys and investigations which would cover many months, it decided also to submit to the two Governments without further delay the data which it had collected and the conclusions which it had reached concerning one branch of the subject committed to it. This it did in its report dated January 8, 1910. The report was forwarded to Congress by the President and was published as House Document No. 779, Sixty-first Congress, second session. An edition was printed also for the use of the commission, at the joint expense of the Canadian and American sections. The report is accompanied by 42 tables, many of them of elaborate character, and by 29 plates. An examination of it will give an idea, though a faint one, of the amount of time and labour expended upon it.

36. There remained to be considered the other kind of works covered by the term "dam," or compensating works. The Niagara River at its extreme upper end is an important safety valve for the protection of Buffalo from the effect of storms upon Lake Erie, and should not be obstructed by a dam, but it was believed that somewhere in the river between Lake Erie and the Falls a submerged dam might be placed which would greatly benefit the navigation of the waters above without injury to those below, and with only minor damages, if any, to the adjoining lands. Without any attempt to "regulate" Lake Erie, the general level of the lake might be raised sufficiently to compensate for the damages heretofore inflicted by the Chicago Drainage Canal and other deteriorating influences. To determine the best site for such a dam it has been necessary to make additional surveys. To determine the best form for this dam, which must be of the submerged type, a large number of experiments upon several different forms was necessary. These experiments were made at the hydraulic canal of the college of civil engineering of Cornell University, the use of which was given free of expense. The results of these experiments were very satisfactory and they will be given in the report soon to be submitted. It was hoped that this work would be completed and a final report rendered before this time, but the illness of a member of the committee, Mr. Coste, and his absence in Europe, has caused an unexpected delay.

INTERNATIONAL BOUNDARY.

37. On the 11th of April, 1908, a treaty was signed between the United States and Great Britain providing for the more complete definition and demarcation of the international boundary between the United States and the Dominion of Canada. It covered the entire boundary from the Atlantic to the

Pacific Oceans, but it prescribed different agencies for doing the work in different parts of the line. Each Government was to "appoint without delay an expert geographer or surveyor to serve as commissioner" for the purpose of doing the work in the various portions of the line except the portion described in Article IV. That article reads as follows:

> 'The high contracting parties agree that the existing International Waterways Commisssion, constituted by concurrent action of the United States and the Dominion of Canada, and composed of three commissioners on the part of the United States and three commissioners on the part of the Dominion of Canada, is hereby authorized and empowered to ascertain and re-establish accurately the location of the international boundary line beginning at the point of its intersection with the St. Lawrence River near the forty-fifth parallel of north latidude, as determined under Articles I. and VI. of the treaty of August 9, 1842, between the United States and Great Britain, and thence through the Great Lakes and communicating waterways to the mouth of Pigeon River, at the western shore of Lake Superior, in accordance with the description of such line in Article II. of the treaty of peace between the United States and Great Britain, dated September 3, 1783, and of a portion of such line in Article II of the treaty of August 9, 1842, aforesaid, and as described in the joint report dated June 18, 1822, of the commissioners appointed under Article VI. of the treaty of December 24, 1814, between the United States and Great Britain, with respect to a portion of said line and as marked on charts prepared by them and filed with said report, and with respect to the remaining portion of said line as marked on charts adopted as treaty charts of the boundary under provisions of Article II. of the treaty of 1842, above mentioned, with such deviation from said line, however, as may be required on account of the cession by Great Britain to the United States of the portion of Horse Shoe Reef in the Niagara River necessary for the lighthouse erected there by the United States in accordance with the terms of the protocol of a conference held at the British foreign office December 9, 1850, between the representatives of the two Governments and signed by them agreeing upon such cession; and it is agreed that whereever the boundary is shown on said charts by a curved line along the water the commissioners are authorized in their discretion to adopt, in place of such curved line, a series of connecting straight lines, defined by distances and courses, and following generally the course of such curved line, but conforming strictly to the description of the boundary in the existing treaty provisions, and the geographical co-ordinates of the turning points of such line shall be stated by said commissioners so as to conform to the system of latitudes and longitudes of the charts mentioned below, and the said commissioners shall, so far as practicable, mark the course of the entire boundary line located and defined as aforesaid, by buoys and monuments in the waterway sand by permanent range marks established on the adjacent shores or islands, and by such other boundary marks and at such points as in the judgment of the commissioners it is desirable that the boundary should be so marked, and the line of the boundary defined and located as aforesaid shall be laid down by said commissioners on accurate modern charts prepared or adopted by them for that purpose in quadruplicate sets, certified and signed by the commissioners two duplicate originals of which shall be filed by them with each Government; and the commissioners shall also prepare in duplicate and file with each Government a joint or reports describing in detail the course of said line and the range marks and buoys marking it, and the character and location of each boundary mark. The majority of the commissioners shall have power to render a decision.

> 'The line so defined and laid down shall be taken and deemed to be the international boundary as defined and established by treaty provisions and proceedings thereunder as aforesaid from its intersection with the St. Lawrence River to the mouth of Pigeon River.'

By this article the "existing International Waterways Commission" was required to ascertain and re-establish, to mark upon the ground, and to delineate upon accurate modern charts, the location of that portion of the boundary which passes through the Great Lakes system, beginning at its point of intersection with the St. Lawrence River near the forty-fifth parallel of latitude and extending through the St. Lawrence River and the Great Lakes and communicating waterways to the mouth of Pigeon River at the western shore of Lake Superior. As the "existing International Waterways Commission" is, and by law must be, composed mainly of engineers, there was in this provision no violation of the rule that the work must be done by experts.

38. By letter dated May 21, 1908, the Secretary of State made known to the American section the provisions of Article IV. of the treaty, and directed them to act under and report to the Department of State in the performance of their duties under that article. The subject was considered by the commission at meetings held in Buffalo June 2, and in Toronto June 23, 1908, and at the latter meeting a preliminary report, submitting a project for the work with an approximate estimate of cost, was prepared and forwarded to the Secretary of State of the United States and the Minister of Public Works of Canada. (Appendix N.)

39. In this project the estimate of cost was spoken of as a "rough estimate" and no estimate of the time required was given. The estimate of cost was for special work under the treaty and did not include the funds needed for the support of the commission itself, which were provided by appropriations for another department of the Government, the War Department. Its amount was $160,000, which being equally divided made a charge of $80,000 to each country. As the work approaches completion it is found that this estimate was remarkably near the true cost, but owing to a necessary increase of the salaries paid to employees it must be increased $10,000, or $5,000 for each country.

40. The most important recommendation contained in the project was that a new set of charts be constructed specially for the purpose of delineating the boundary. The charts of the United States Lake Survey are the most accurate modern charts existing of the region under consideration and they represent the highest type of surveying skill but it was found they were unsuitable for the delineation of the boundary for the following reasons, viz., the scales of these charts which vary considerably are not the most convenient for this purpose, being in some cases so small that the boundary could not be shown clearly. The size of the sheets is not uniform, making it impossible to prepare a neat portfolio with easy reference, such as is required for a record of such importance as that of the boundary. They contain an immense amount of detail which is of no use in connection with the boundary and would serve only to obscure it. The geographical co-ordinates used in constructing the charts were ascertained with the greatest precision attainable at the time, but these have in recent years been the subject of revision. The triangulation of the Lake Survey has been connected with that of the Coast and Geodetic Survey and from this connection has been derived the United States standard datum, to which all the more recent charts are referred. It is found that considerable corrections are required to give the older charts their proper places on the earth's surface, and that admirably as these charts serve their practical purpose, which is to aid navigation, they are as published not scientifically and theoretically correct. At certain places the information which they furnished was not complete enough for boundary purposes, and additional field work was required.

In the opinion of the commission it was necessary to construct a new set of charts, and with the approval of the two Governments that work was undertaken.

41. The new charts are to be 30 in number, including an index chart. There will be 18 charts on a scale of 1:20,000, to include 7 for the St. Lawrence River, 2 for the Niagara River, 2 for the Detroit River, 2 for the St. Clair River, 4 for the St. Marys River, and 1 for Pigeon Bay; 5 charts on a scale of 1:60,000, to include 1 each for the eastern end of Lake Ontario, the western end of Lake Erie, Lake St. Clair, northern end of Lake Huron, and eastern end of Lake Superior; 4 charts on a scale of 1:300,000, to include 1 each for Lake Ontario, Lake Erie, Lake Huron and Lake Superior; 2 charts on a scale of 1:10,000, to include 1 each for Niagara Falls and Sault Ste. Marie; and 1 index chart on a scale of 1:1,200,000. They are to be of the uniform size of 40 inches by 50 inches within the border. They will show the shore lines of the lakes, rivers, islands, and the mouths of the more important streams; the location of all the principal cities and towns and of all the lighthouses and other permanent aids to navigation; all hydrography available from the United States and Canadian surveys; all the geographic positions upon which the projections are based; and the boundary line, with all monuments used to mark it; unnecessary topography and all other matter not necessary for the special purpose will be omitted. They will be projected and drawn directly upon copper plates, from which exact copies may be made in any desired number. Distortion of scale and errors in copying will thus be avoided. One set of copper plates having been prepared a duplicate set will be made by electrotyping, and one set then deposited in the archives of each Government.

42. Through the courtesy of the Secretary of the Treasury, additional rooms in the Federal building at Buffalo were assigned for the use of the commission, and the necessary furniture provided, certain special articles being made to order from designs furnished by the commission. Competent experts for projecting the charts and engraving them on copper were employed, and the work was fairly inaugurated in the autumn of 1908. It was under the immediate personal direction of the American secretary of the commission, but was closely supervised by a committee composed of Prof. Haskell, representing the United States, and Mr. Stewart, representing Canada, who in turn reported and received instructions at every meeting of the full commission. The expert employees were taken from both countries in equal numbers as far as possible. There was much difficulty in finding suitable persons as engravers.

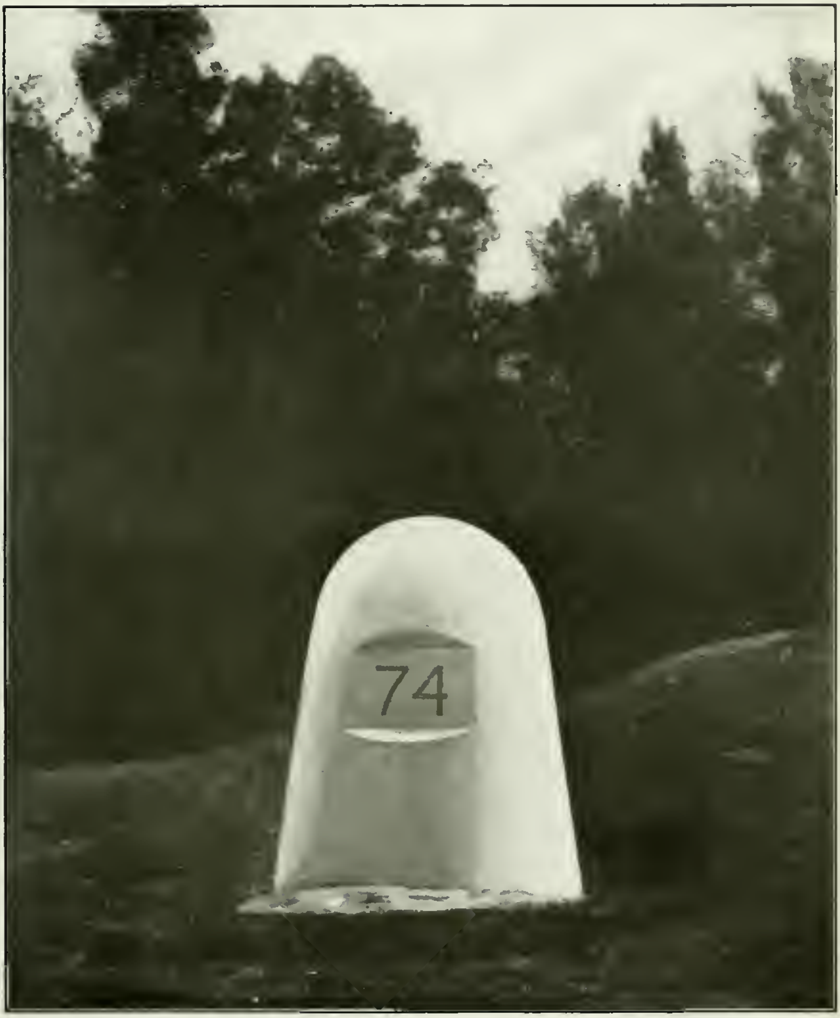
43. The greater part of the data for the new charts were to be found in the Engineer Bureau of the War Department. Under the authority of the Secretary of War, the Chief of Engineers, United States Army, placed at the disposal of the commission the original large scale manuscript charts constructed in the office of the Lake Survey, and other records of his bureau. The commission has been constantly in correspondence with that bureau, and we desire to acknowledge the promptness and courtesy of the two successive Chiefs of Engineers, who have held office since the work began, Gen. W. L. Marshall and Gen. W. H. Bixby, in answering all of its calls for information. Much valuable information was obtained from the Canadian Hydrographic Survey. It was found necessary, however, to send out surveying parties to make a considerable number of detached surveys to supplement the information on record. The commission has made 16 separate surveys in all, some of them, as the Niagara River, from Lake Erie to the Falls, being quite extended. It is believed that but little more field work will be necessary.

44. The work upon the charts is of two kinds, viz., constructing or drafting work, and cutting the copper or engraving work. In the following table is given the state of completion of each kind of work upon each chart on the 1st of November, 1912:

	Chart.	Scale.	Per Cent Completed Nov. 1, 1912.	
			Engraving.	Drafting.
1	St. Lawrence River	1: 20,000	98	100
2	"	1: 20,000	98	100
3	"	1: 20,000	98	100
4	"	1: 20,000	98	100
5	"	1: 20,000	98	100
6	"	1: 20,000	98	100
7	"	1: 20,000	98	100
8	Eastern end of Lake Ontario	1: 60,000	90	90
9	Lake Ontario	1:300,000	....	55
10	Niagara River	1: 20,000	98	100
11	"	1: 10,000	98	100
12	"	1: 20,000	98	98
13	Lake Erie	1:300,000	98	98
14	Western end of Lake Erie	1: 60,000	98	100
15	Detroit River	1: 20,000	98	100
16	"	1: 20,000	98	100
17	Lake St. Clair	1: 60,000	98	100
18	St. Clair River	1: 20,000	98	100
19	"	1: 20,000	98	100
20	Lake Huron	1:300,000	....	20
21	North end of Lake Huron	1: 60,000	70	100
22	St. Marys River	1: 20,000	98	100
23	"	1: 20,000	98	100
24	"	1: 20,000	98	100
25	"	1: 10,000	95	98
26	"	1: 20,000	98	100
27	Eastern end of Lake Superior	1: 60,000	98	100
28	Lake Superior	1:300,000	....	95
29	Pigeon Bay	1: 20,000	90	100
30	Index		10	100
	Total		83·7	95·1

About 84 per cent of the total work of engraving and about 95 per cent of the total work of drafting upon all the charts was completed November 1, 1912.

45. A decision as to the actual location of the boundary is being reached by successive steps, and can not be made final until the new charts are completed. The engineer members of the commission prepared a tentative delineation of the line on the existing charts, replacing the curves in the old line by a series of straight lines, which they presented to the commission at its meeting of December 23, 1908. It was intended as a preliminary study, and no action was taken except to consider and discuss it. As the work of constructing the charts progressed it was found desirable to know approximately the location of the boundary before the completion of the copperplates in order to avoid cutting the soundings in a way which would interfere with the clear delineation of that line. It seemed possible to make a location upon existing charts which would answer these requirements and would be another step toward the future final location. At its sessions of August 3 and 4, 1909, the commission went over the existing charts with great care, having before them the report dated June 18, 1822, of the commissioners appointed under the treaty of Ghent, December 24, 1814; also the Webster-Ashburton treaty of August 9, 1842; also the protocol of a conference held at the British foreign office December 9, 1850. They tentatively agreed upon a line which they fixed upon the old charts as accurately as the scale of the charts would permit, with the understanding that at any time thereafter, either side should be at liberty to propose alterations. Later on, as the new charts reached a sufficiently advanced stage, proofs were struck off, and the tentative



TYPICAL MONUMENT.

Height above ground, 2 feet 6 inches; diameter at base, 2 feet; diameter at top, 1 foot 6 inches; radius of hemispherical top, 9 inches; foundation to extend 5 feet below surface of ground; material, concrete; copper pin inserted in the top to mark the point with precision.

line was transferred to them. The necessity of a revision at some places then became evident. When the work of marking the boundary upon the ground was taken up, the desirability of additional changes appeared. These changes have been made from time to time, until now it may be said that the line has been agreed upon except at three places—Niagara Falls, Lake St. Clair, and Sault Ste. Marie. Although the tentative agreement applies to these places also, there are some differences which may cause the question to be re-opened.

46. Much study was given to the form and character of the monuments to be used in marking the boundary upon the ground. In the climate of the Great Lakes a buoy is a temporary device which, if used, must be taken up at the end of navigation in the autumn and replaced in the spring, and can be employed only by some permanent organization. Permanent monuments alone are available for this commission. Manifestly it is not expedient to place such monuments upon the turning points inasmuch as these points are all in water, where in many cases the monuments would be obstructions to navigation, and where they would often be very costly to build on account of great depth. It was decided to place them on shore, one as near as practicable to each turning point. With the range and distance of the turning point known it will be easy to find it whenever it may be necessary to know it with precision. After careful investigation it was decided to build the monuments of concrete, in the form of the frustrum of a cone with a hemispherical top. The height above ground is 2 feet 6 inches; diameter at base, 2 feet; diameter at top, 1 foot 6 inches; radius of hemispherical top, 9 inches; foundation to extend 5 feet below the surface of the ground. A copper pin is inserted in the top to mark the point with precision. Each monument has a separate number cast in its side at the time of fabrication. A photograph of one of these monuments is inclosed.

47. The work of placing the monuments was begun upon a small scale on the St. Lawrence River in July, 1910. It was experimental and resulted in demonstrating the neatness and effectiveness of the type adopted. It was pushed with vigour during the seasons of 1911 and 1912, and was completed in September of the latter year. The number of monuments placed is 88 on the St. Lawrence River, 34 on the Niagara river, 58 on the Detroit and St. Clair Rivers, 43 on the St. Marys River, and 4 on Pigeon Bay, or 227 in all.

48. In attempting to connect these monuments with the old surveys it was found that a large number of the old station marks left by the Lake Survey had disappeared, and that it was necessary to connect the monuments by a new triangulation system. The field parties were organized so as to take the necessary observations in connection with building the monuments. It is necessary to work up these notes, and compute therefrom the geographical position of each monument before it can be placed upon the chart. Considerable progress has been made in this work, but it will probably require the greater part of the current year to complete it and after its completion some months more will be required to place the results upon the charts.

FURTHER DUTIES OF THE COMMISSION.

49. From the foregoing recital it appears that many questions have arisen and been considered which were not anticipated when the commission was created, except in a very general way. It was expected that questions generally resembling these would arise, but exactly what they would be was not known. It seems certain that similar questions will arise hereafter. All such questions will be considered by the International Joint Commission created by the treaty between the United States and Great Britain, dated January 11, 1909. That commission takes the place of the International Waterways Commission in the consideration of all new questions. The latter has therefore completed the work

for which it was originally organized, except its final report upon a dam at the outlet of Lake Erie. It has assumed that it would be allowed and expected to complete its work upon that subject, the difficulty and importance of which have been explained in an earlier part of this report. There are not two commissions covering the same ground, but rather one commission retiring from a field which it has long occupied and clearing the ground for its successor.

50. Quite distinct from the duties of investigation and report assigned to the commission when it was originally organized are the executive duties assigned to it by Article IV. of the treaty between the United States and Great Britain, dated April 11, 1908. The treaty is specific in designating the "existing International Waterways Commission" as the agency by which a certain specified portion of the boundary is to be defined, delineated upon charts, and marked upon the ground. For this purpose the International Joint Commission does not take the place of the International Waterways Commission. The work is mainly engineering work, and should be, as it is, in the hands of a commission composed mainly of engineers.

51. The commission therefore has two pieces of work to complete before it can with propriety go out of existence; one its final report upon a dam at the outlet of Lake Erie and the other its work upon the boundary. International courtesy requires that the American members be allowed to join in completing the former, and treaty obligations as well as international courtesy require the same regarding the latter.

52. The American members have rendered annual reports to the Secretary of War since their organization and to the Secretary of State also since 1908, but the work of the commission has been unobtrusive, and much of it has up to this time not been well known to Congress. We can not but think that the provision in the Act approved August 24, 1912, calling for this report and limiting the appropriation for the support of the commission to December 31, 1912, means simply that Congress desires information before making further appropriation, and has no intention of putting a sudden stop to important work, in an unfinished condition, in which we are engaged with a foreign nation.

53. It will be quite impossible for the commission to complete its work by December 31, 1912. From a year to 15 months more time than that will be required. As has already been stated, the project of June 23, 1908, for the boundary work gave no estimate of the time required. The novelty of the work, as well as the uncertainty as to what amount of surveying in the field would be required, made it impossible to estimate the length of time which would be needed. The commission as a body has never expressed any opinion upon the subject. Some of its members believed at the outset that the work could be completed in three or four years, and the chairman of the American section, in answer to a question, once expressed that opinion to the Appropriations Committee of the House of Representatives. It has proved to be erroneous, but the error has done no harm. The treaty required the work to be done without reference to either tie or cost. The opinion was not given until after the project had been adopted, the character of the work defined, and the work itself well started. It had no influence upon the question of accepting or rejecting the project. The only precedent of which we have knowledge which can give an approximate idea of the time required to do this kind of work, is that of the commissioners under the treaty of Ghent, who preceded us in going over this same ground. Those commissioners held their first meeting November 18, 1816. Five and one-half years later, June 18, 1822, they reported an agreement as to a portion of the line, and a disagreement as to another portion. They held their final meeting December 24, 1827, having submitted separate reports concerning the portion in disagreement, that of the British commissioner dated October 25, 1827, and that of the American commissioner December 12, 1827.

Thus they were engaged upon the work more than 11 years in all, and were unable to complete it. These facts were known to those who negotiated the treaty of April 11, 1908, under which we are acting. The commission has pushed the work as rapidly as it was able to do it. In the light of experience it may now be positively stated that the length of time employed is not unreasonable. It is to be remarked that the marking of certain portions of the line not intrusted to this commission will not be completed until several years after the completion of the commission's work.

54. Funds for the use of the commission are provided upon two separate appropriation bills; those for the support of the commission itself upon the sundry civil bill upon estimates submitted by the War Department; those for the special work upon the boundary, exclusive of the support of the commission, upon the diplomatic and consular appropriation bill, upon estimates submitted by the State Department. For the latter the amount originally estimated was $80,000, all of which has been appropriated, but as explained in paragraph 36, an additional appropriation of $5,000 will be needed to complete the work. This additional appropriation and the unexpended portions of former appropriations for the boundary cannot be used, however, unless provision be made for the support of the commission itself. The annual appropriations for that purpose have been $20,000, practically all of which has been expended in the salaries of the commissioners and their secretary, travelling expenses, office rent, clerical services, and other necessary office expenses. For the current year the appropriation is only $10,000, and is available only for the first half of the year, that is, until December 31, 1912. Application will be made for $10,000 to be appropriated in the urgent deficiency bill, to cover the second half of the year. A list of all the appropriations heretofore made by Congress for the use of the commission will be found in Appendix O.

55. There is still some doubt as to the length of time required to finally complete the work, as must always be the case where two coordinate independent bodies, such as the two sections of an international commission, are working together, but it is reasonable to hope that it can be completed by the 1st of April, 1914. In its estimate for the next fiscal year the American section has therefore asked for funds sufficient to carry it to that date, or $15,000. The total amount remaining to be appropriated then is for—

Special boundary work, diplomatic and consular bill	$ 5,000
Support of commission, second half of current fiscal year, urgent deficienve bill	10,000
Support of commission, part of fiscal year 1913-14	15,000
Total	$ 30,000

Very respectfully,

O. H. ERNST,
Bridg. Gen., U.S.A., Retired,
Chairman of American Section.

GEORGE CLINTON,
Member of American Section.

E. E. HASKELL,
Member of American Section.

Attest:
W. EDWARD WILSON,
Secretary of American Section.

LIST OF APPENDICES.

A. Report upon the water-power situation at Niagara Falls, as concerns the Canadian power companies,and their associated transmission companies by the American members, September 29, 1906.

B. Report upon the water-power situation at Niagara Falls, as concerns the diversion of water on the American side, by the American members, November 15, 1906.

C. Report upon the form of permit for the diversion of water from the Erie Canal, by the American members, March 5, 1907.

D. Report upon the request of the Niagara Falls Hydraulic Power & Manufacturing Co. that they be protected in their rights in any treaty negotiated with Great Britain, by the American members, September 9, 1907.

E. Report upon the diversion of water at the Whirlpool Rapids below the Falls in Niagara River, by the commission, March 3, 1908.

F. Report upon the conditions existing at Sault Ste. Marie, by the commission, May 3, 1906.

G. Report upon the application of the Minnesota Canal & Power Co. for permission to divert certain waters in Minnesota from their natural flow, which is into boundary waters, by the commission, November 15, 1906.

H. Report upon the application of the International Development Co. for permission to construct regulating works in the Richelieu River, by the commission, November 15, 1906.

I. Report upon the Chicago Drainage Canal, by the commission, January 4, 1907.

K. Report upon the location of the international boundary through Lake Erie, by the commission January 4, 1907.

L. Report upon the application of the Cedar Rapids Manufacturing & Power Co. for permission to build power works in the St. Lawrence River at Cedars, in the county of Soulanges, by the commission, April 13, 1909.

M. Report upon the application of the Long Sault Development Co. for legislation to authorize the construction of power works in the St. Lawrence River, near Long Sault Island, by the American members, March 11, 1910.

N. Project for the more complete definition and demarcation of the international boundary, under Article IV. of the treaty of April 11, 1908, by the commission, June 23, 1908.

O. List of appropriations heretofore made for the use of the International Waterways Commission.

SUPPLEMENTARY DOCUMENTS

In reference to the Minnesota Canal Power Company
and the Chicago Drainage Canal.

THE MINNESOTA CANAL & POWER COMPANY.

The application of the Minnesota Canal & Power Company is dealt with in a report of the Commission, which is to be found at page of this volume. The Commission held two public hearings on this subject, one in Toronto, Ont.,on June 5, 1906, and the other in Buffalo, N. Y., on June 27, 1906.

Public hearing of June 5, 1906, presided over by Mr. George C. Gibbons, K. C., Chairman of the Canadian Section and at which the full Commission was present.

INTERNATIONAL WATERWAYS COMMISSION.

QUEEN'S HOTEL, TORONTO, June 5, 1906.

O. H. SIMONDS, Esq., representing The Minnesota Canal and Power Company addressed the Commission as follows:—

Mr. President and Gentlemen of the International Waterways Commission: I have not had an available opportunity of attending any if your previous meetings. I am unaware as to the procedure before you and if you, in the course of the remarks I make, feel that I go beyond the lines of professional conduct that you expect, I shall be glad to have my attention called to it. I shall be glad to be interrupted frequently, with a view to throwing additional light on the subject. I have no means of knowing to what extent you are familiar with the questions arising around the construction of the proposed works of The Minnesota Canal & Power Company, although I have been furnished with a list prepared by Col. Ernst showing the documents, the papers and maps which have been delivered to him from the War Department at Washington and which I presume he has here. I have with me duplicates of most of these papers so far as they emanate from The Minnesota Canal & Power Company, and if thought desirable I shall be glad to file them—one for the Canadian Section and one for the American Section. What I would like to do is to make you understand so far as I can the situation in Minnesota relating to the plans of this Company so that when you take it into consideration with the other matters which have been submitted to you touching the boundary waters between the United States and Canada that you will act in an intelligent manner with a knowledge of what the real situation is, I shall be somewhat embarrassed to know how much to go into detail in relation to this subject. I have heard it said that the speaker is one and the hearer is another. It is idle to speak unless it be to communicate information which this Commission desires to have and ought to have to enable it to properly discharge its duties. At the same time I don't want to go into length of detail or tire the Commission out and in that respect I shall be glad to receive any suggestions that any of you may wish to make from time to time. The conformation of land in Minnesota which has given rise to the works of this company is briefly this.

Duluth is situated on the northerly shore of the west end of Lake Superior. Immediately behind that city there rises a high bank of land which, within the limits of the city, reaches an elevation of 600 to 700 feet and then gradually rises as we pass north. It would be possible then to secure a 600 foot head to any water power proposition where the water could be brought to the highlands back of the city. There is a stream entering into the head waters of Lake Superior known as the St. Louis River, which is being improved by the Great Northern Power Company. They acquired rights on that river and are making improvements and will soon have works in operation installing something like 30,000 horse power. I suppose the conditions there in the respect I am about to mention are the same as they are here; that the precipitation is approximately upon the average 30 inches and that it is extremely uncertain and irregular. In the natural condition of most of our streams the flood waters run off quickly and that leaves us with an extremely low water level in times of drought. The consequence of that is that the extent of any power which anyone might undertake to establish upon any of these waters would be limited to the minimum flow of whatever water there is unless opportunities existed by which a considerable amount of storage of flood waters could be secured. This Company has been examining this question for many years and in considering the St. Louis River, which at one time it had under contemplation to improve, it found that the facilities for storage were extremely limited and difficult to obtain; that, without extraordinary expense, unusual care and the adoption perhaps of heroic and possibly forbidden methods, anything like a reasonable run off from that watershed would not be secured, and the works must necessarily be limited to somewhere near the minimum flowage. To illustrate this, the flood flow of the St. Louis River is perhaps 18,000 or 20,000 cubic feet a second; its minimum flow is about 600 cubic feet per second. In prosecuting our examination of the country we fell upon what is known as the Birch Lake drainage area, and that will be a matter of discussion and presentation here by myself, Mr. Silverman, Mr. Rockwood, who represents opposing interests, and I suppose by others. There is a situation around Birch Lake which is a little lake about 10 or 15 miles long and perhaps ½ to ¾ of a mile wide, and which has a drainage basin of about 1,100 square miles and which is located about 800 feet above the level of Lake Superior, 1,400 above the sea level, there is a situation by which substantially all the water which flows into that basin gathers into Birch Lake and from Birch Lake it passes on north through various lakes and streams and finally into Basswood Lake which is upon the boundary between Canada and the United States, and then along down through lakes and streams until finally the Lake of the Woods is reached. The formation of that part of the country is rock. It is a new country. The growth above the soil is of timber, pine, cedar, tamarack and other woods of minor importance to pine. Pine is the most merchantable and valuable. The other timbers are of less value, but still they form the subject of extended commercial operations. This country is a rocky country. It is a country where the rock comes to the surface very frequently. The covering of this rock with soil is slight. This is a country of lakes; it is a country with a large number of lakes which are connected by short streams and these streams uniformly run over a natural dam, at the foot of each lake, made of granite or whatever the formation is. It was the proposition of the Minnesota Canal and Power Company to take these waters and divert them from their natural channel and pass them down to Duluth and there use them, thereby creating a waterway of considerable importance between Birch Lake and the City of Duluth, also diverting water over this waterway to Duluth and there using it for power with a head of 600 feet. In that respect I think it is unique, so far as head is concerned. I am not aware of any place where an equal opportunity can be derived in this country east of the Rocky Mountains.

Mr. Coste: Do you get a sheer head there ?

Mr. SIMONDS: No, the pipe lines or conduits of the works would probably be 5,000 feet in length. There is a gradual slope, although it is steep—I should suppose about 30 degrees—at Duluth. If any of you have been there you are aware that the country rises right up from the water edge almost. This Birch Lake drainage basin lies next to the St. Louis River basin, and the watershed between these two bodies of water is less than 40 feet, I think about 32 or 33. It looks as though Providence designed originally to have that water run down to Lake Superior and in the very end possibly changed its mind and put up that divide and then left it for the human family to utilize it by changing its course. We propose to cut a divide from the Birch Lake Reservoir to Embarrass River, which flows into the St. Louis. The water flows in the St. Louis to a point back of Duluth and then through a public canal to be built by the Canal Company 24 miles in length to the works. It possibly would throw a little light on the minds of you gentlemen if I should display a map at this point in which the whole matter would be shown.—Shows map No. 6 and explains to Commission.

Col. ERNST.: Did that catalogue include everything which you presented to the Department?

Mr. SIMONDS: I think it does. I have just duplicated the catalogue with what I have brought here. I wish to file two additional plans that would contain a virtual history of the proposed performance of this Company from the very beginning. If you will look closely at Map No. 6 you will note that it not only shows Birch Lake but the reservoir which includes it. We have designed several large reservoirs having a total capacity of about 10,000,000,000 cubic feet, and if you look closely you will see which is the lake and which is the reservoir. The lighter colour is the reservoir and the deeper colour is the lake. It is proprosed to make a reservoir of Birch Lake and raise the water in it twenty feet.

COL. ERNST: You have four dams and a controlling works.

Mr. SIMONDS: Yes. It looks to me like a meritorious proposition, and I suppose that a proposition of that kind within a reasonable limit of cost undertaken by members of the human family would commend itself to the consideration and approval of any body of men having a twentieth century mind.

In working out this plan, however, we necessarily touch and affect other interests and it is on that ground that this matter has been referred to you gentlemen and it is to discuss I suppose the relation which the carrying out of this enterprise would have towards surrounding interests that we have come here to-day.

These adverse interests might be divided into two or three classes. Just how far the jurisdiction of you gentlemen extends I do not know. It is possible I may refer to some features of this matter with which you have no concern, but it would be an ideal position to tell the story of this enterprise so that you may understand what its general bearing is, then leave you to select such portions of this interview as fairly belongs to you for your consideration. Of course in working out a large enterprise of this character it becomes necessary to condemn a large amount of land and the right to use this water. We have proceedings pending in the Minnesota courts involving 700 to 800 descriptions of land that will be affected in one way or the other, land for canals, reservoirs and overflowage. These proceedings are now pending and are being forced to a decision as fast as possible. Later I will give the history of those a little more in detail. We encounter the property owner in the first place and our proceedings are adverse to him; that is, where we propose by the strong hand of the law to take possession of his lands for public use. Another class of men that we have encountered—and

I concede they have nothing to do with these people—are those who own land to be sure but who are depending—the conformation of whose land is such that a potential water-power may exist upon their land. Mr. Silverman is a man in that position. This river—there are a multitude of rivers here—flows north from Birch Lake across the land in which Mr. Silverman has an interest—ownership being in the Enterprise Iron & Land Company—where there is a fall of 60 or 70 feet and where a water-power might be created. As yet no improvements of that character have been made. We also encounter in another place where there is a fall of twenty or thirty feet, land owned by a man by the name of Spelman and his wife. We encounter another situation where there is a boom company who desire this water for a portion of the year for booming their logs down to the mill. That would include from our standpoint the company represented here by Mr. Rockwood. Now as far as these people are concerned our plan is to dispose of them through the State courts and if we take any tangible and available property from them we expect to have to pay for it. We can take property if we are acting in good faith on behalf of the public, but we must pay for it. This second class have filed protests in our proceedings and you find them here upon your table. I perhaps ought to say that we encounter a large amount of government land belonging to the United States, and also some State land, but under the laws of our State the State land can be taken; as to lands of the United States, Congress has passed laws and established regulations under which they can be devoted for our purposes. An application to the Secretary of the Interior under the statute was made sometime ago and this second class of interests I have referred to, have filed protests there against the granting of our requests, principally on the ground that their personal interests would be involved and affected. When we come to pursue the natural water-way still further we find that it becomes a boundary water between the United States and Canada and that within twenty or thirty miles of leaving the Birch Lake basin as designated by me that it passes into the waters of the boundary line and remains so substantially for 200 miles. 150 miles down are the works of The Koochiching Company, and then it passes down to the Lake of the Woods. There remains still another question. Before reaching that question I ought to say that before we can divert these waters we are required to submit our applications to Congress or the Secretary of War and secure the authority of the Secretary of War, we will say as applicable to this case, for our works. That would be in all cases where the streams affected are public, navigable waters of the United States. We have had this matter up pretty thoroughly and the War Department officials held that these are public waters of the United States. We have accepted their contention and are proceeding on the theory that they are public waters of the United States. Early in the history of these matters we were informed that a protest had been filed with the Secretary of State of Canada at Ottawa and I visited Ottawa for the purpose of ascertaining what it was. I found that the Enterprise Iron & Land Company had filed a protest there against our diverting this water. Mr. Silverman is a man whose interests are affected but whose remedy—whose real remedy—is in the State courts of Minnesota and I cannot see where he has special interests in the questions that might arise here. Subsequently there was filed a protest with the Secretary of State by the Corporation of Fort Frances or by citizens of Fort Frances. As a matter of fact I think that the protest filed by Mr. Silverman, which was very informal, was never acted on but the protest filed by the citizens of Fort Frances was sent to Washington and passed eventually into the Secretary of State's office, and I think that is one of the reasons why the subject is referred to this Commission. Probably Mr. Rockwood knows more about that than I do. The Koochiching Company has its works at Fort Frances and it would not require on my part a strong stretching of the imagination to think that Mr. Rockwood had something to do with the filing of that protest. We have had to meet this question. When we filed our application to the Secretary of the Interior he upon his own motion referred the matter to the Secretary of War, to see whether in his opinion any questions arose that were under his jurisdiction, and his reply was that such questions might arise and our application was denied on the ground that we had not applied to the Secretary of War. This will all appear to anyone who takes the pains to read this somewhat voluminous record. We however filed Replies to Protests and the matter was then referred to the Secretary of War to examine into it from the standpoint of the public and navigable character of these waters and was then referred by the Secretary of War to Major Derby of St. Paul and to Major Potter of Duluth, both of the corps of engineers of the United States Army for an examination. Public notice of this reference was made; a day was fixed for hearing; everybody who had an interest was invited to be present and be heard and there was a long hearing occupying an entire day attended by all interested so far as I know who were involved in the matter.

Mr. Gibbons: Where was that?

Mr. Simonds: Duluth.

Mr. Gibbons: Were there any Canadian interests there?

Mr. Simonds: None except Mr. Rockwood if you put him in that class. We take him to be an American citizen in Minnesota. How far he represented Canadian interests I do not know, but he represented The Koochiching Company; Mr. Silverman was represented through his attorney, Mr. Spelman was represented through his attorney, and the various power companies were represented through their attorneys and the matter was very thoroughly threshed out. Major Derby to whom the responsibility of our proposed plans were more particularly referred—Major Potter was included in the reference because there were certain questions arising in the St. Louis River which I need not refer to here—the general jurisdiction of the boundary waters was under Major Derby's control and subject to his general jurisdiction. The question was submitted to them and a report was made which is on file here with you and is included among the papers I have offered to file. Now we found in that hearing that our previous contention that these were private waters in which the government had no interest would not be sustained by these army officers. They held that according to the best knowledge that was available that they were public waters of the United States and must come within the jurisdiction and under the laws of Congress. Major Derby is a man of a more or less constructive temperament however, and he made a report in which he subjected us to certain rather serious conditions, but on our complying with those conditions he recommended that our plans be approved and so it was sent on to Washington, and inasmuch as the whole inquiry had emanated from the Interior Department it was referred back to it, and an intimation was contained in the reference—which you can consult here—so far as it appeared on the face of the papers that if application should be made to the War Department that it might be possible it would be justified in approving of the plans of the company. Then of course the matter of the Canadian protest had to be disposed of. I have been trying to get some kind of a hearing for sometime. I had some correspondence with Col. Ernst from which I was rather of the opinion that the jurisdiction of the American Section was doubted but later it was referred to the Commission by Secretary Root. Now that is about the story of it and we find ourselves in this position: That we want to create that waterway from the Birch Lake Drainage Basin to Duluth. We want to use the water at Duluth for the distribution of power, but we are opposed in it by the several interests mentioned and by the protest filed by the Corporation of Fort Frances. We are here to define our position in relation to this whole matter and we have reached the conclusion that our legal attitude in relation to this business is substantially this: That so far as the public has an interest in these waters—whether that public be the public of the United States or the Dominion of Canada—that we cannot interfere with their use.and that this Commission and in fact probably no body that could be created could permit us to do so. We have come to the conclusion that as to the State of Minnesota that whatever public interests there are in those waters, whatever rights of navigation, are held by the state as sovereign and cannot be conveyed to us or anyone else and must so remain, and we have somewhat modified our original idea with the wider knowledge and more extended experience covering a prolonged fight. We know that Birch Lake country and the position we take is that we desire to divert these waters subject entirely to the public rights and interests therein. If it so be that these waters can furnish navigation to the public that navigation must be maintained. Under the laws of Minnesota if those waters can be utilized advantageously for even the running of logs we hold ourselves subordinate to that proposition, but with those principles aside we claim the right to divert the water and that our original proposition should be permitted, namely, that we should be permitted to gather up these waters and reservoir them and deliver such portion of them to the City of Duluth as can be done without detriment to the public interest. We have inaugurated some proceedings in the state courts. We brought a proceeding against The Koochiching Company, who are represented by Mr. Rockwood. In our principal proceeding covering a part of the Birch Lake Basin the Judge held with our contention and appointed commissioners. In the case of The Koochiching Company the district court declined to appoint commissioners on the ground so far as I understand that he was not satisfied that our articles of incorporation limited us to the use of this water for public purposes; that it might be possible within the scope of our articles of incorporation that we could devote it to a private use. The law is well settled gentlemen that it would be impossible for any government to take property away from one man and give it to another, but where organizations are created for a public use they are permitted to take the lands of others by paying a reasonable compensation therefor and it was held by this judge that inasmuch as we have combined in our plans public and private uses as he contended, we ought not to be permitted to proceed. We desired to possess this water for the purpose of generating electricity to be distributed among all people who might wish to use the same, and we also desire the right to sell water directly from the wheels to any user who might desire to use the same. The trial court was of the opinion that while the creation of power and its distribution by electricity was a public use, yet in connection therewith the furnishing of water to a private owner, that is to any person to use without the intervention of electricity, was a private use and that the two being combined we must fail in our case. I am stating now more the question of the Supreme Court which afterwards disposed of the case than I am of the trial Court, but we will pass right on to the Supreme Court. The matter was heard and disposed of the last of March. The Supreme Court held just as I have stated, that one of the uses proposed by us was private, that the other use was a public use, and that we having combined the two there was no way of determining which was public and which was private. The court also took up the question of the power conferred by the statutes of Minnesota upon corporations of this kind to divert water from one watershed to another as we propose to do and in the conclusion decided adversely to our contentions. That decision was based upon a variety of circumstances. We were and are of the opinion that some of the reasons assigned were unwarranted. For instance the court held that inasmuch as the United States statute required the consent of Congress or the consent of an officer of the Government—the Secretary of War in this case—to the use of public waters and that we had not secured that consent that they could not render a judgment which would enable us to take these waters against the laws of the United States. That opinion has not been published. I have a certified copy of the opinion here. I presume Mr. Rockwood has.

Mr. Rockwood: I don't know when it will be published. The West Publishing Company is for some reason quite a way behind. I understand it is on account of a printers' strike.

Mr. Clinton: Have you furnished a copy.

Mr. Simonds: Have you got a copy of the opinion of the trial court

Mr. Rockwood: Yes, it is very brief. It may throw some light possibly on the decision of the Supreme Court. So far as the discussion of the legal question is concerned the opinion of the trial court was contained in half-a-dozen lines.

Mr. Simonds: Since the decision of the Supreme Court and under the light of that decision the corporation has amended its articles of incorporation and if there was any question of a private use involved in the original articles I think that idea has been completely eliminated. The contention that an added use to a recognized public use was a limitation instead of an expansion was a surprise to the people who incorporated the Canal Company, but it having been so held we respect and abide by it and change our course to obviate the difficulty.

Mr. Clinton: The articles of incorporation now limit your power to the generation of electricity.

Mr. Simonds: They are very short and I will read them.

Mr. Coste: This is a new corporation

Mr. Simonds: No, it is the same corporation entirely. I was going to say that since this proceeding was made we have amended the articles which I have referred to and which I will read and we have filed in lieu of the original petition a new petition. I may say also that there has been a revision of the laws of the State of Minnesota upon all subjects which went into effect on the 1st of March. This matter was submitted prior to that time. It was submitted in January and was decided under the old law, but there has been a revision in which the powers conferred upon corporations of this kind are somewhat larger and I would be glad to furnish you with copies of such sections of that law or with the body of the law itself as would bear upon that question. I suppose that these questions are not of the most material character here, provided that it appears that there is a fair probability that the proceedings are warranted by law.

Mr. Gibbons: I see how you get over in your articles the private use. How do you get over the objection that it interferes with the United States and Great Britain with reference to the boundary waters?

Mr. Simonds: I will try and throw a little light at all events on our view in relation to it. These articles provide that the corporation is organized

"To generate electricity in the State of Minnesota by steam or water-power for public use and to distribute and supply such electricity to the public for light, heat and power purposes; to construct, maintain and operate canals and improve navigation and to supply the public with water; to purchase, lease, construct, own, operate and maintain all dams, reservoirs, canals, ditches, embankments, pipe lines, transmission lines, power-house and other buildings and machinery and all subways, conduits and other works and appliances which shall be necessary or convenient for performing the business and accomplishing the purposes above set forth; and to acquire by purchase, gift, lease, license, condemnation and other lawful means any and all property, rights, easements and franchises which shall be necessary or convenient for carrying on the business and accomplishing the purposes of said corporation as herein expressed.

"It is hereby declared to be the object and purpose of this corporation to acquire, construct, operate and maintain all the works and appliances hereinbefore mentioned and to do all the things hereinbefore authorized for public use on equal terms and for a reasonable compensation, subject to the supervision and control of the State of Minnesota."

That amendment of the articles has not as yet been submitted to any legal construction, but if it is not limited to a public use it is because the attorneys of the company were unable to prepare articles which would give expression to that idea. I would like to read two or three of the allegations in the petition which is now pending and which came up for hearing last Saturday and was put over two or three weeks.

"2. That for the purpose of accomplishing the objects for which it was organized as aforesaid your petitioner has undertaken a work of internal improvement for public use, which is described as follows, to wit:—

(a) The construction and maintenance of a continuous navigable water course from and within the territory hereinafter described and designated as the Birch Lake Drainage Basin in St. Louis and Lake counties, Minnesota to a point in section twenty-two (22) in town forty-nine (49) north, range fifteen (15) west in that part of the City of Duluth commonly called West Duluth, which shall include the construction and maintenance of a navigable canal connecting said Birch Lake Drainage Basin with the Embarrass River, thence along said Embarrass River to a point in the northerly end of Sabin Lake in section eighteen (18) town fifty-nine (59) north, range fifteen (15) west and the improvement of the Embarrass River and the lakes along the course thereof and the St. Louis River below the outlet of the Embarrass River down to a point in section sixteen (16), town fifty (50) north, range seventeen (17) west in St. Louis County, Minnesota; the construction and maintenance of a navigable canal from said last mentioned point on the St. Louis River easterly to said point in the City of Duluth in section twenty-two (22) which is approximately six hundred (600) feet above the level of the Bay of St. Louis at said City of Duluth and the construction and maintenance in connection therewith of a suitable device or chute for delivering logs, lumber, timber, forest and other products from the east end of said canal at the point last described to and into the said Bay of St. Louis, which canals shall be of such size, dimensions and capacity as to allow the floating of canal boats and barges and other water-craft thereon for the transportation of merchandise and to allow the floating of logs, lumber, timber and forest products thereon, which water-course shall be capable of delivering the logs, lumber, timber, forest and other products from said Birch Lake Drainage Basin and from said St. Louis River and its tributaries to and into the Bay of St. Louis at the said City of Duluth and the water tributary to the St. Louis River Canal hereinafter described.

(b) The furnishing and distribution, by means of such water-course and said work, of water to municipalities, persons and corporations for public use.

(c) The generation of electricity by means of the water-power hereinafter described and the supplying of such electricity for public use to all municipalities persons and corporations desiring the same, for light, heat and power purposes, which water-power shall be created by conducting in pipes and conduits the water so diverted from the east end of said St. Louis River Canal, to the power plant of your petitioner, which will be located at or near the level of the Bay of St. Louis at said City of Duluth under a head of six hundred (600) feet or thereabouts.

(d) The diversion into said water-course of such portion of the waters of the said Birch Lake Drainage Basin as may be required to carry out the purposes of this corporation and the diversion of which will not interfere with the navigation, navigable capacity or public use of the waters of the said Birch

Lake Drainage Basin and the various lakes and streams to which they are tributary and the diversion into said St. Louis River Canal of the waters tributary thereto.

And that all of said works are to be constructed and maintained for public use on equal terms by all municipalities, persons and corporations for a reasonable compensation subject to the supervision of the State of Minnesota.

3. That the Birch Lake Drainage Basin hereinbefore referred to consists of that certain tract of land in St. Louis and Lake Counties, Minnesota, the waters of which run into Birch Lake in said Counties together with all the territory whose waters drain into the Kawishiwi River, above the dam hereinafter described to be erected in section twenty-eight (28), town sixty-three (63) north, range ten (10) west in Lake County, Minnesota, and the extent of said Birch Lake Drainage Basin is about eleven hundred and three (1,103) square miles.

4. That the average annual run-off from said Birch Lake Drainage Basin is about 35 billion cubic feet of water, practically all of which can be reservoired by your petitioner and conducted into and through its Birch Lake Reservoir hereinafter described by means of its proposed works as herein described and, after the diversion of the water which your petitioner proposes and seeks to make from said Birch Lake Drainage Basin through its said water-course to the City of Duluth, there would be left a large quantity of water sufficient for all purposes of navigation and public use and that your petitioner, by reason of the storage of water as herein set forth, would be able to distribute water along the natural water-course below Birch Lake hereinafter described in such a manner as to improve the navigation of such natural water-course and the public use thereof.

5. That the waters of said Birch Lake Drainage Basin are covered with ice for an average of six months of every year and during that period no navigation or running of logs or public use thereof is practicable; that said waters flow north from Birch Lake through Birch River, White Iron Lake, Garden Lake, Farm Lake, Fall Lake and the connecting streams into Basswood Lake; thence north along the boundary waters between Canada and the United States into the Lake of the Woods.

6. That none of the streams in said Birch Lake Drainage Basin and none of the streams connecting the chain of lakes between Birch Lake and Basswood Lake are capable of navigation for any purpose whatever except at certain short periods of the year for the running and driving of logs when aided by artificial means.

7. That the navigation and public use of none of the lakes in said Birch Lake Drainage Basin and none of the lakes through which said waters of the Birch Lake Drainage Basin flow will be injuriously affected by the diversion of water therefrom as proposed by your petitioner."

Now we claim in relation to this Commission and in relation to the attitude which the authorities of Canada ought to take in relation to it, that really the Canadian people occupy the same position toward these waters on the boundary line as the United States Government occupies with reference to them within the territory of the United States. They stand as trustees for these waters so far as any public use of them is concerned. Here is what we would assume to be a meritorious enterprise which ought to prevail we think to the full extent that it can be prosecuted without the violation of public rights. This boundary between Canada and the United States is a line which extends for thousands of miles. I am not aware that all the questions which have been submitted to you gentlemen have been disposed of, but I conceive that the whole matter is one that must be treated in a fair and reasonable spirit and for the purpose of really advancing the interests of both countries. I would not undertake to say just where the balance shall be struck . It is a very difficult thing to get at. The diversion of waters is no new thing in the history of the world. The people of the United States undertook to divert Canadian waters as early as 1825 through the Erie Canal. So far as I know that was the first diversion of water on boundary lines. That was followed by the Canadian people who diverted water from Lake Erie by the first and second Welland Canals. The question has arisen as to the distribution of the water of St. Mary's River. My information is that this Commission has had this matter up before it and reached a conclusion and that the question has been entirely settled as to how these waters shall be disposed of. When we go farther west the matter comes up as to the question of irrigation. Now, I want this Commission to decide this matter in such a way as to promote the interests of the United States and of Canada. It is hard for me to pick out the individual interests and separate them from the other interests that may arise. It may be that the Canadian interests are getting more than the American interests; I don't know. Whether they are entitled to more I don't know. At the Soo, I took a clipping from a paper as I was coming here on the train from which the impression that I got—I don't know what the fact is—is that at the Soo the water-power to be generated as agreed to on the Canadian side was in excess of what the natural equities would be. I may be wrong about that. The item was very limited and there is no use of my speaking about it. I think that the duty of the Canadian Section of this Commission is done when it sees that the public interests are protected. When those interests are protected I think that its duty is done just as well as the duty of the American Section is done when it sees that the public interests are protected. A most thorough examination, as I said, was made before these gentlemen of the Engineer Corps of the Army, Majors Derby and Potter, and I should think their examination of the question with all the parties before them and all the questions before them—I don't know whether the Canadians were represented in person, because Mr. Silverman, Mr. Rockwood and the St. Croix Lumber Company have all availed themselves of Canada's position as a reason why this matter should not be one between our people alone. But on all other matters they are Canadians and represent Canada in that country. You have no idea what able representatives they are. I will read just a little further to show the attitude that we take and all that I ask you gentlemen to do is to permit us to go on with our works so far as they will not interfere with these public navigation interests.

Mr. Gibbons: Who shall be the judge of that as to Canada? What are we going to say to our people who come to us and complain that the waters of the Rainy River will be lowered? How are we going to meet that?

Mr. Simonds: I will tell you how Major Derby works it out.

Mr. Gibbons: We have seen his report. For instance that provides for a dam entirely in Canadian territory.

Mr. Simonds: It was on the boundary.

Mr. Gibbons: No, Keewatin.

Mr. Simonds: If you will allow your mind to be diverted for a moment the question with Major Derby during progress of the hearing was as to the effect that the proposed diversion which we were going to make would have upon the depth of water in the Lake of the Woods and we sent our engineers to Rat Portage to examine the situation there and see what controlled the depth of the waters and we found that some Canadian Corporation had built a substantial strong dam there and that the present elevation of the waters of the Lake of the Woods, to say nothing about the future, was determined by the operation of this dam with its stop logs and that the United States was dependent upon the manipulation of those blocks, as well as the Canadians, for a reasonable depth of water in that great lake. Major Derby when this information was laid before him made a communication to the Secretary of War recommending that the matter of the maintenance of this dam be taken up between the United States and Canada and recommended that it was important that this dam should be maintained for that purpose. These are photographs of the dam (showing photographs to the Commission). That was a matter he said that whether our contentions were allowed or not, he should take up and would undertake to bring about, and the matter so far as we are concerned was left in that condition. Then there are other dams which he recommended should be built. Of course there may be practical difficulties arising betweeen the two countries in relation to it. I suppose that matters of that kind can only be adjusted by representation between the countries—individual parties can hardly be involved in them directly. I think that Major Derby's idea was that we ought to look at this matter from a constructive standpoint. Here are vast natural resources which during the past have gone to waste and now the time has arisen when it seems as though some substantial benefit could be realized by the human family by the improvements it is proposed to make. It is that spirit which has induced the work at Niagara Falls. Of course at Niagara Falls another proposition is encountered. The question is raised as to how far the scenic effects at Niagara Falls should be interfered with by the efforts to utilize water for the purpose of power. Such I do not think can be involved in the proceedings that we propose in our scheme. Of course you see a great deal has been spoken about 600 cubic feet a second, but the attitude that we take is that we cannot ask properly for any particular quantity of water that we should be able to take from these lakes, but that we must be limited in the amount taken by its effect upon the public interest. This Birch Lake Drainage Basin is approximately six per cent of the drainage basin of the Rainy River at Koochiching. It is about three per cent of the drainage area tributary to the Lake of the Woods. If it so be that 600 cubic feet a second can be taken from this water—shed without interfering with navigation and other interests it then would represent about three per cent or three and a half per cent of the territory tributary to the Rainy River and one and a half per cent of the territory tributary to the Lake of the Woods. Those contentions were worked out with a great deal of care by Mr. Banks, but they were set entirely aside by Major Derby in his report. He said in effect—I don't want to set any difficulties in the way, but what I want to do is to protect the public and navigation interests and subject to that protection you can go on with your improvement. Of course it is not much to say that the 600 cubic feet per second which we would like to take out from the boundary waters near Birch Lake are restored to the boundary waters of the United States and Canada and that it passes along down past us here. 600 cubic feet a second is not very much in this vast water-shed and in this vast flowage of water. But it is as much in fact as we propose to take out. We are not destroying this water. We are taking it out of a very large water-shed and it is a very small percentage of the flowage of the drainage basin. Further than that let me add that this water which we propose to take can only be secured by going into an extensive system of storage. Now I referred to the uncertainty of this flowage. In the Birch Lake basin the flood flowage is 4,400 cubic feet per second and the low water flowage is 220 cubic feet per second. The engineer for The Koochiching Company stated that the high water flowage in the drainage basin tributary to Koochiching was about 50,000 cubic feet a second and the low water at that time was estimated by him to be 3,500 cubic feet a second. I have read the contract between Canada and The Koochiching Company in relation to that matter and I can say that they are possessed of the same idea, that this water must be reservoired. Yet I can see that they are looking forward to the time when they will have the privilege themselves of storage. Now as a matter of fact The Koochiching Company has had prepared various plans and expect to install we will say 16,000 to 20,000 h. p. If they should install 20,000 h. p. they would be unable to use any more than 40 per cent of the flowage of water at that point. If we have put ourselves in a position so that we can use this water and not interfere with the public, and by that I mean the interests of navigation, we have got to put in this large storage system to save this flowage of water which would do no good to the interests of navigation and no good to the Koochiching Company.

Mr. Gibbons: They seem to decide two points against you. First that the assertion of private uses made it improper; second that there is no statutory right to divert a water—shed from one national stream across to another, especially where it is boundary water.

Mr. Simonds: If you will let me read a few paragraphs I will refer to it.

Mr. Gibbons: Do I understand the decision?

Mr. Simonds: You have a rough hewed judgment of it (Reading from petition:)

"8. That your petitioner's said works and the diversion of water as proposed by your petitioner will not interfere with the navigable capacity of any of said waters and will not interfere with any navigation of which they are capable, and your petitioner's works can and will be so conducted as not to interfere with such navigation or any public use thereof, but on the contrary so as to aid and facilitate the same and so as to increase and improve the navigable capacity of said waters."

We take the risk and we expect in this case to finally secure a judgment in which our use of this water will be limited in this language or any other proper language.

Mr. Gibbons: There is one point I would like you to go further about. They go further and say "They have no jurisdiction.............upon the rights of riparian proprietors in Canada".

Mr. Simonds: I am going to ask you to let us out.

Mr. Gibbons: Your own Supreme Court in Minnesota held that they had no jurisdiction to give you this charter because the changing of this water from one water-shed to another would be illegal. Have you not got to get the opinion of this Court again in Minnesota?

Mr. Simonds: Oh yes, we have got to go to that same court. I wish to read just a little further along the same line showing the attitude in which we have put ourselves before the court and then I will see what I can say in relation to this matter and discuss this opinion. A copy of this paper will be left here.

Mr. Clinton: I suppose Mr. Simonds the reason is that this is a question of fact that it will interfere with riparian rights?

Mr. Simonds: No, I think the report will go a little further than that and I want to explain to Mr. Gibbons in relation to it.

Mr. Gibbons: (Reading from Opinion) "The trial court refused to grant the petition because the purposes for which the petitioning corporation is organized and for which it seeks to condemn the lands and rights sought to be condemned . . . . . are not all public uses, but private uses are involved in and possible thereunder."

Mr. Simonds: What you have read is based upon a category of reasons which I would like to present to you, now that the question has been raised. The court is considering the disposition of the first point as to whether the Legislature of the State of Minnesota has conferred authority upon corporations of this character to condemn property of others under circumstances where it would amount to diversion from one water-shed to another. It refers to many causes. It quotes in the first place the sections of the law which I won't stop to read at this moment, but I shall read what it says about it.

"Taking these sections together it is apparent that the Legislature has not expressly authorized the condemnation of land for the construction of a canal which is primarily designed for the creation of power, but incidentally for purposes of navigation. See note 61 L.R.A. 853 (a). Sec. 2592 authorizes the taking of private property for public use in the construction of canals to be used as public highways, but the subsequent statute restricts the canals which may be thus constructed, to certain localities, by limiting the right-of-way which may be condemned, to such as is for a canal running parallel to the water-course. The grant is of the right "to canal in and along the valley of any river, bay, stream, lake or water-course."

Now the court regards that language as in the statute in a limitation upon the right to divert water from one watershed to another. In the statute itself the power is not conferred. It is rather limited to "canal in and along the valley of any stream." The statutes in that respect were built up by many amendments at different times. The first enactment was in 1866 and there have been many amendments, but in the revision which went into effect in March, 1906, this restraint is not found so that whatever argument may be based on that would fall to the ground, for the statute has been changed.

Mr. Gibbons: (Reading from Opinion) "The doubt as to whether the legislature intended to grant such power is strengthened when we consider the nature of the waters which the petitioner seeks to divert from their natural courses. It is not seriously contended that the Birch River is not a navigable stream, as defined by the courts of this and other states, in which logging and lumbering is extensively carried on. The streams through which the water of Birch Lake finds its natural outlet are navigable in fact and have in the past and will in the future to an ever increasing extent be used as highways for the carriage of logs and the general products of the soil of the surrounding country."

Mr. Simonds: Now that is another consideration which affected the minds of the court. The final judgment of the court, except in some modification of facts and contentions, we are bound by. But I submit to you gentlemen the question as to whether the court has thought out that reason correctly, and as to whether the court itself when it comes to consider the question will not change its views so far as that reason is concerned, and whether such change may not affect its final judgment. Now what is this Birch Lake country? I have told you that it is a rugged and rocky wilderness up there. It has a crop of timber on it. That crop of timber, as a matter of fact, is being worked off now and will be worked off within the next eight to fifteen years entirely, so far as I know. I don't know what may be discovered hereafter, but there is nothing then to take its place. Instead of the traffic in the way of running logs, etc., being ever on the increase I submit to you that it takes 100 or 150 years to raise a forest and that you cannot expect another forest to be created there during the present and the two ensuing generations.

Mr. Gibbons: (Reading from Opinion) "The public have a right of way in every stream which in its natural state and ordinary volume is capable of transporting to market the products of the forest or mines or the soil along its banks. It is not essential that the property to be transported shall be carried in vessels or guided by the hand of man. Nor is it necessary that the stream shall be capable of navigation against the current or that it shall be navigable at all seasons of the year. It is sufficient if from natural causes, it is navigable at certain seasons."

Mr. Simonds: We considered that proposition. Whatever navigation there is there now and whatever shall be, will have preference over our rights. Right in this connection I would like to show a profile of that country. It would throw a little light on the situation. Now I want you gentlemen to look at that (profile) and understand it as fully as possible and I will go through this opinion and tell you how it strikes me and what we are going to ask the Supreme Conrt of the state to do. There are no rivers in that country up there. It has a lot of pools or lakes connected by streams—Produces profile and shows to Commission.

Mr. Gibbons:What is the total fall?

Mr. Simonds: It is about 300 feet to Koochiching; below that it is not so much. There is about 20 feet drop in the Rainy River. (To Mr. Banks, engineer of Canal Company:) What is encountered at the feet of each of these lakes or pools that holds them to their levels?

Mr. Banks: Almost invariably there is a granite ledge.

Mr. Simonds: '(Reading from Opinion). "What has been said with reference to the navigability of Birch River applies equally to Birch Lake and the other lakes from which the appellant proposes to draw the water. For the purpose of ascertaining whether the state has authorized this interference with navigable water it is necessary to examine the prohibitions which are found in the organic law of the state as well as the statutes. In the Ordinance of 1787 we find the statement that: 'The navigable waters leading into the Mississippi and the St. Lawrence and the carrying places between the same, shall be common highways and forever free as well to the inhabitants of said territory as to the citizens of the United States and those of other States that may be admitted into the confederacy, without any tax, impost or duty therefor." The act authorizing the inhabitants of the Territory of Minnesota to form a state government provides: 'That the said State of Minnesota shall have concurrent jurisdiction on the Mississippi and all other waters bordering on said State of Minnesota so far as the same shall form a common boundary to said State and any other State or States now or hereafter to be formed or bounded by the same and said river and waters and the navigable waters leading into the same shall be common highways and forever free as well to the inhabitants of the said State as to all other citizens of the United States without any tax, duty, impost or toll therefor.' Substantially this provision appears as sec. 2 of Art. 2 of the constitution of the State. The first legislature which met under the constitution passed a law which now appears as sec. 2385, Gen. Stat. 1894 and provides that: 'All the rivers within this State of sufficient size for floating or driving logs, timber or lumber and which may be used for that purpose are hereby declared to be public highways so far as to prevent obstructions to the free passage of logs, timber or lumber down said streams or either of them.'"

We cannot interfere with that. We have got to see that that right is maintained. So far as we are concerned that is what we are prepared to do. I think perhaps the court has misunderstood our attitude. Perhaps it was not so clear as it is today. (Reading from the Opinion):

"It is conceded that Birch Lake and Birch River and the other waters referred to are meandered waters and sec. 6878 G.S. 1894 makes it a public offence to "drain or attempt to drain any lake, pond or body of water in the state which has been meandered" unless under express statutory authority. Dowlane *vs* Sibley Co. 36 Minn. 430. To unlawfully interfere with or obstruct the navition of any lake or navigable river is a public nuisance. Sec. 6613 G.S. 1894. Congress has also expressly prohibited the obstruction of any navigable waters of the United States without its consent (Fed. Stat. Ann. Vol. 6 P. 783, 813, Sec. 10) and the state is powerless to authorize any obstructions which would be a violation of the federal statutes."

That is right. Our theory of that matter was different from what this judge seems to have taken. We have got to go to different tribunals in order to acquire the different classes of rights that we desire. And if it should be held, for instance, by this tribunal that they would not under any circumstances grant this consent until we have acquired that consent of the State, and if the United States Government would refuse to act until we had received the consent of this Commission, and if the state should persist in saying that it would never grant our petition until we acquire the Canadian Government's consent, you would see that we would be blocked in the game without bringing the whole matter to an issue. All that we ask of this Commission relates to the matters that are properly before it and over which it has jurisdiction. If we should get the fullest authority from this Commission and then we could not get permission from the Secretary of War the thing would be blocked. If we got the consent of the Seretary of War and the Supreme Court should say, This is not a case where we could authorize the condemnation of property then we cannot go any further. We have got to appear before these various tribunals and get their consent to the different points involved.

Mr. Gibbons: If the State didn't grant you permission our permission would not be of any use?

Mr. Simonds: None whatever. You could give us the freest permission in the world, but we would be barred entirely until we could convince the Supreme Court. We would like to have you give us what you can now and we would like the United States Government to give us what they can and we will get the Supreme Court to our view just as fast as we can get it there. (Continuing reading:

" Congress has also expressly prohibited the obstruction of any navigable waters of the United States without its consent (Fed.Stat. Ann. Vol. 6 P. 783, 813, Sec.10) and the state is powerless to authorize any obstructions which would be a violation of the federal statutes......In U.S. vs Rio Grande Dam & Irrigation Co. 174 U.S. 690 it is held that the diversion of waters from a navigable stream to such an extent as to appreciably impair its navigability is an 'obstruction' within the meaning of the statute. It is true that the trial court has found that the carrying out of the appellant's enterprise would not substantially interfere with the capacity of the lakes for navigation or any other public use to which they have at any time been put. This finding deals entirely with conditions as they have existed in the past and does not determine that the enterprise will not interfere with the more extensive use of the waters which is inevitable in the future as the country develops and navigation increases."

We have got to let the future in some respects take care of itself. But in order to meet that position we allege that that diversion will not interfere with any navigation that will arise upon the water-course.

"The court does not find that it would at times prevent the floating of logs over the rapids in the rivers connecting the lakes within the State unless the petitioner's dam should be so separated as to furnish water for the driving of the logs down the stream at such times as there should be logs to drive—'and it would not be impossible to so separate said dams'. This means that the navigation of the streams would be placed under the control of the appellant to be regulated as it should see fit, thus giving to it as an incident to the power to create a canal and a water-power at Duluth the overlordship and control of navigation on large and important public waters of the State."

Mr. Gibbons: Is not that the necessary effect?

Mr. Simonds: I think not. I think that it is not fair to presume that any citizen or any corporation engaged in the performance of a lawful act will violate the law which controls its action. If such a violation should take place there are all kinds of remedies to be applied by any injured party, but I submit to you gentlemen whether it is fair to assume that we would act in violation of the supreme law of the land so far as the State of Minnesota is concerned in carrying out these grants and whether there would be any good policy in doing it. Now suppose we were able to carry the "Big stick" would it be policy for any sane corporation to work out its business in that way when it would put itself at the mercy of anybody who might consider himself to be injured and whose entire performance could be restrained? If we carry through this project and engage in the development of this power and find customers at Duluth and elsewhere we have got to furnish them with power. We have got to put millions into it in order to succeed in getting this result. I think it would be a suicidal position for any company to put itself, in which by its own act it would cause trouble and disaster to itself.

"We find no such grant and in view of the presumption in favour of the rights of the individual, the State and Federal prohibition against the obstruction of navigable waters, the rule that the rights of the state in such waters are sovereign and not proprietary that they are held in trust for the public as highway and cannot be alienable, the fact that the doctrine of the appropriation of waters, adopted in some of the western states, does not prevail in Minnesota."

Now you are a lawyer and the other members of the Bar upon this Commission will understand what the allusion is here. The necessities or the interests of the people in the Western States, particularly those States where irrigation is required to bring out and develop the country have abandoned the doctrine of the common law as applicable to cases of this kind and have gone lengths perhaps which have not been followed in the east. This court says it is not followed in the State of Minnesota. It probably never will be followed in the State of Minnesota unless some overwhelming cause arises.

Mr. COSTE: It is because we have too much water.

Mr. SIMONDS: I suppose so. I suppose the uses to which you put this water are not the highest use to which it could be put. Irrigation is a matter of life or death to a land. You have got to have irrigation in order to supply the land and because of that a community no doubt would adopt more liberal rules than in cases where that extraordinary necessity does not exist. So far as all these various objections are concerned, I concede that it is possible for the officers of the United States Government to deny the application which is virtually referred in part to this Commission. I do not expect them to do it if on a careful consideration of the subject they find it is a meritorious enterprise which will not interfere with public interests. When we come to this Commission, while it is possible that this Commission may report to their respective governments that this ought not to be done I do not expect it to do so except on a very careful consideration. If on the other hand this diversion can, by reason of extraordinary storage, be made, without injuring the public interest, I expect under proper and reasonable limitations you will allow it to be done. I may say that the same interest which affected the minds of the Corps of Engineers should affect your minds. We are here for a reasonable thing. We do not want to tread on the rights of any person or on the rights of the public. We have the right to condemn lands of individuals but we are required to pay for it. (Reading from Opinion):

"The treaty relations between the United States and Great Britain with reference to the boundary waters between the United States and Canada." I have a copy of that treaty although it does not directly refer to this situation; it is immaterial whether it does or not. All of us are here and should be here for the purpose of working out these natural resources that have been supplied to us for the best advantage of the human family and one man should not be allowed against all reason to have his way against the interest of another. What is a reasonable and fair thing to do is what this Commission ought to watch, or any other. Of course this Commission is not bound by any statutory law. They do what seems to them to be the reasonable and fair thing to do. We expect to be bound by the decision of the Supreme Court of Minnesota. Three of these judges agreed in this judgment. The prevailing opinion is the law of the land at the present time. The other opinion is a much more pleasant one to me but we have got to convince the three other judges of that court.

Mr. Gibbons: Is the court constituted the same now as it was?

Mr. Simonds: Yes.

Mr. Gibbons: (Reads from dissension) "The natural, fair and reasonable import of the language employed in the statute authorizes the incorporation of companies for the purpose of constructing, maintaining and developing canals for the purposes of navigation and also for the purpose of creating water power, for public use, and confers upon such corporations the right of eminent domain to the extent necessary to carry these objects into effect. Such improvements may be developed independently or they may be worked out jointly and there is nothing in petitioner's articles to justify the assertion that navigation is not one of the primary objects to be attained."

Mr. Simonds: I would like to say in that respect in self abasement that the attorney who drew the articles which are referred to in these opinions undertook to incorporate pretty nearly the entire substance of the statute in the purposes of the corporation and he got up a sentence of something like seven hundred words which contained about all that was to be found in this statute authorized in one way or in another. It was very confusing to the trial court. Mr. Rockwood himself couldn't understand it. The trial judge was dissatisfied with it and thought it was a horrid conception, and while the Supreme Court held it was good so far as legal effect was concerned yet they gave it a very bad literary criticism. (Continuing reading.)

"There is no reasonable ground for the conclusion that it was the intention of the legislature to limit the right of way for such canals to the particular watershed where the waters are to be secured. There was no object in fixing such a limitation since it would prevent the working out of the very spirit and purposes of the statute.

It is not material in this case that the lakes and streams constituting the Birch Lake water-shed are navigable waters and find a final outlet into an international stream. It is of no importance that the enterprise diverts a portion of these waters over a divide into another water-course. The question here is, how much, if any, does the working out of the plan damage respondent in its capacity as a riparian land owner, by diverting waters which would otherwise flow by its premises. To the extent of the injury suffered in such capacity compensation must be assessed. But in so far as respondent is interested in common with the general public, it has no standing in court to raise objection to an interference with public rights in navigable waters. All of respondent's private interests, however affected, may be condemned and paid for, such interest being subject to the rights conferred upon public service corporations.

This proceeding does not undertake to interfere with public rights. There is no attempt here to condemn them. The State has no authority to confer such authority and if in putting the scheme into execution petitioner diverts waters so as to affect the public interests, therein, then the constituted public authorities may call it to account or enjoin the infringement. In this case, however, the trial court accepted every position (save one) contended for by petitioners, found the public interest required the development of the enterprise and did not find that respondent would be damaged in the least. The court denied the petition upon the grounds only, that private interests were subserved.

I dissent also from the decision of the majority to the effect that there is such a distinction between water power converted into electrical energy and water power *as such*, that the former is susceptible of public use, whereas the latter is only available for private use." That is a matter in which you have no special interest.

Mr. Gibbons: He didn't consider the effect on public interest at all. He sought to state that all he was considering was whether the people there could assert public rights. It does not really affect our issue very much.

Mr. Simonds: It couldn't affect it. We might get a unanimous decision of that court giving us all kinds of powers to divert this water and it would not affect your position one iota.

Mr. Gibbons: It is not an issue here. This court has dealt with that.

Mr. Simonds: I have stated what I think this tribunal ought to do, and it is only a reasonable thing which I ask them to do. This is all I wish to say in relation to it unless there are any persons who wish to ask any further questions.

Col. Ernst: You have not enlarged at all upon what means you would adopt to alleviate private rights and Canadian citizens; they have some rights.

Mr. Simonds: I cannot answer the question. I don't suppose that can be done in any way except through the general governments of the two countries. Now, so far as damages are concerned, we have only met a few people situated like the Koochiching Company and we made Mr. Silverman and Mr. and Mrs Spelman parties defendant for this reason. In most places where water flows along a shore and its depth has no noticeable effect the damage is nothing. Now Mr. Silverman claims damages from us because the situation in his case is that in some of his lands he has an elevation of 65 feet. He says while this water is flowing through my land I might put in a pipe and generate some power. Now we have made these people defendants in the State of Minnesota, all those that we thought whose interests would be affected at all. No man who owns property abutting on the still water of the lake is affected and the only people on the boundary waters, so far as our suits have gone, that we thought advisable to make defendants were the Koochiching people. The Koochiching Company is a private corporation as I know it, organized under the laws of the State of Iowa and they have rights from the United States to build bridges which is not involved here, and to make dams and they have contracts with the Canadian authorities. We made them defendants as practically a Minnesota corporation and so far as I know there are no other persons that might be fairly included among our respondents on either side of the river whose interests would be affected one way or the other.

Mr. Gibbons: Is not there a public interest in having the flow go in its natural way?

Mr. Simonds: Do you mean a sentimental interest?

Mr. Gibbons: No, a substantial using interest. The municipal right to develop power. What you call a public interest.

Mr. Simonds: Now here is the Government of Canada which holds control of its navigable waters I suppose—

Mr. Gibbons: We don't hold control of them where they go across the boundary.

Mr. Simonds: That is a matter that will have to be disposed of. We will eliminate the boundary question just for the second. Take the Mississippi

River. Why is this left with the Government; because that river stretches from one end of the country to another and it is only handled properly through the general government and through the officers appointed in that service. Col. Ernst has been in that service for a number of years. I do not know whether he with his experience could point out any other interest in which the waters of those great lakes are used except navigation. Now when it was sought to divert water for the Chicago Drainage Canal the question was how it affected the navigation on the Great Lakes. I suppose that is a matter which has not been undisposed of. I have had correspondence with Col. Ernst and with Mr. Randolph the engineer of the Sanitary Canal and he said that the diversion had no discernable effect. Col. Ernst, your own engineers say that they have calculated that after five or ten years that this Chicago diversion would lower the lakes from three to six inches.

Col. ERNST: A parallel question would be if we were taking a Chicago drainage canal from some course and putting it into the Mississipi.

Mr. SIMONDS: I cannot answer that question any more than this, what other than navigation interests in waters do you know of in your experience that has become a public interest, the public interest that is held by the State as sovereign. Now Mr. Silverman owns his property and it belongs to him as a matter of fact. It is his property. He can sell it if he sees fit. If we should offer enough to Mr. Silverman he would convey his property, but the State of Minnesota cannot sell what it stands for. It is a trustee and must forever be such and its rights in the navigable waters in the State cannot be disposed of, and it must not stand up through the Supreme Court or any other way and allow its water interests to be so handled as to interfere with the public use of those waters! So with Canada with this water. Of course when you bring two governments together you bring about other questions. Now this line between the United States and Canada does not trouble me. If you put yourself in perspective you see that while these boundary lines have been established the questions that arise have to be worked out for the general benefit of mankind.

Mr. COSTE: Let us suppose The Minnesota Canal & Power Co. have this charter; how do you propose to maintain the level for navigation purposes?

Mr. GIBBONS: And who is to control it?

Mr. SIMONDS: So far as the United States is concerned that control is necessarily invested in the Secretary of War and in the officers of the Government.

Mr. COSTE: As a company what work do you propose to do?

Mr. SIMONDS: We cannot look any further into the scene than anybody else. This is a new proposition. We are required by Major Derby, we would be required by the law of the United States to maintain a dam at a certain place which is designated or within a certain range we would store as much of the flood water as we can draw out from the Birch Lake drainage area, and we would allow that water to run out from that broad reservoir as the Secretary of War may direct.

Mr. GIBBONS: Those are streams in the United States; what about the International streams?

Mr. SIMONDS: That was applied to that particular stream. Now of course we have got to get into a workable condition. It would be possible for the Canadians to take one attitude on the navigability of that stream and the Americans another. You are tied together anyway and you cannot get apart. It is an international stream; it is a navigable stream. The interests of navigation require that something should be done. The people on the Minnesota side applied to Congress this last Session to get a board of engineers to make a survey and report on the project of the improvement of Rainy River and see what it would cost, but I think the reply was that the Chief of Engineers did not recommend that that should be done by the United States alone. When Canada comes along and says we see that you have raised the question, let us see what can be done, it can then be considered.

Mr. Coste: You claim you can take 600 cubic feet out of this stream and yet not damage navigation in any shape or form?

Mr. Simonds: I claim that exactly as a matter of fact under the requirements of Major Derby, that we shall store flood waters that would otherwise run away. The attitude I want to leave with you gentlemen is that we do not stand for the diversion of any particular number of feet. We hold ourselves subject to navigation, and we cannot divert one foot a second if it interferes with the navigation of the waters that are depending upon the water thus diverted. It is the only thing that you should determine. If we cannot find a way to provide for that navigation as well as it is provided for now we shall have to go out of business.

Mr. Coste: I can quite understand by construction of certain dams you could restore the level of the waters to the extent you take. Rainy River would look to be the only one which would require special control of.

Mr. Simonds: Now Major Derby's idea was that we should put in works there and that he should have control of it.

——Mr. Rockwood agreed to furnish copies of opinion of S. Court.

——Mr. Simonds offered to furnish sections of the revised Statutes of Minnesota, on this question.

Mr. Rockwood, representing the Koochiching Company addressed the commission as follows:

There was, as Mr. Simonds has stated, and as all the members remember, an application by this company to the Secretary of the Interior which was disposed of or substantially disposed of. This present application was filed last August and when Mr. Simonds was serving notice of it he let me off through some oversight I suppose, and I didn't know until last Thursday when I received a letter from the Chairman of the American Section, Col. Ernst, that any such application had been filed. I heard a day or two before that there was an application. I was in Duluth Friday and called on Mr. Simonds and he then gave me a copy of the printed application. I left home Sunday evening. Saturday I was very busily occupied and I have not consequently had time to make preparations and make as succinct a statement as I should make had I been given more notice. Possibly at the same time this discussion that has already taken place has eliminated some of the questions which it was necessary for me to cover, so fully covered them that a general understanding seemed to have been arrived at. At any rate I will go ahead and make a statement as briefly as I can and perhaps ask permission to either put it in writing or to add to it. There are interests that are not represented here to-day which I know desire to be heard. I think some of them have made formal requests for a hearing in Duluth. Is not that true?

Mr. Gibbons: The people in Duluth have made a formal request for a public hearing.

Mr. Rockwood: Mr. Grannis, representing the St. Croix Lumber Company, is the one who made that statement to me and I think that he wrote me that they would request additional time and also that they would request a meeting of the commission in Duluth. Now the application, which I suppose this commission is considering, is one prepared last August, based on the original application of the company as to what its legal rights, its legal powers and the legal powers of the two governments might be, and it asks definitely for the right to take 600 cubic feet of water per second continuously year in and year out from Birch River and carry it over into the other water-shed. Whether the commission will consider that request or the request that is now made, which as I understand it is, for permission to put in certain works and then to take as much water as may be from time to time permitted, I don't know. The request to the Secretary of War and referred to this commission is the request to take 600 cubic feet per second. Now I want to discuss that petition in both aspects as briefly as I can. This lake and water-shed which is tributary to this lake embraces 1,100 square miles. The water-shed of Rainy River above Koochiching Falls is 16,000 square miles and a few odd. The 1 100 square miles is seven per cent—not six as Mr. Simonds has stated, but seven. That is not a very big difference, but one per cent of that water-shed is a considerable item, one per cent is a large item. The average rainfall of this Birch Lake water-shed is estimated to be about thirty inches. Of course that is an estimate. It is based on records that have been kept at Duluth and there is no such thing as exact knowledge on that point. The petition which was filed first in the district court in St. Louis county by this company or the application which was made by the company to the Secretary of the Interior—I have forgotten which—states that the annual precipitation varies from a maximum of 45 inches to a minimum of 19 inches and fractions in each case. The run-off is estimated to be forty per cent—the mean annual run-off the 30 inches—or twelve inches. Now if there are twelve inches run off during a year it amounts to 980 or 985 cubic feet per second on the average and of that 985 cubic feet per second this company ask the privilege of taking 600 cubic feet or a little less than two-thirds. The minimum flow is stated to be 220 cubic feet per second. Now this water-shed is like all other water-sheds and the most of the water goes off in flood or during the period of comparatively high water. The Company proposes to construct some reservoirs as its application states—its new petition doesn't state—proposes to impound the waters so as to be able to take away continuously 600 cubic feet a second. Now it has not furnished yet so far as I have seen, to the commission, or to anybody else, a statement of what the total capacity of its reservoirs is going to be.

Mr. Simonds: Ten billions.

Mr. Rockwood: I was a little inaccurate. It has not been stated what proportion of ten billions can be drawn off.

Mr. Simonds: All of it.

Mr. Rockwood: The Birch Lake Reservoir as I understand it is going to be constructed by raising the natural level of the lake about twenty feet, and it is within that total Birch Lake reservoir that you get the ten billion feet.

Mr. Simonds: It is the upper thirteen feet.

Mr. Rockwood: Those figures were asked for in court. At any rate this is true, that the storage capacity of the reservoirs that are to be provided are not nearly sufficient to impound and hold and control the entire run-off of the area. Now that water that is not controlled because of lack of capacity of these reservoirs is still going off in the high water period. It is going down the streams in the high water stage when it is not particularly needed. If the company operates its water power with any degree of success it must have this constant flow of 600 cubic feet and I want to come back to that question of quantity a moment later in the financial aspect. It must have this constant flow and during the period of low water and lack of precipitation it will be financially compulsory upon the company to turn all of the water it can through its canal or hold in its reservoirs and send as little as possible down the stream. Now it is stated that the project means an investment of millions of dollars and it certainly does. How much?

Mr. SIMONDS: Four or five millions.

Mr. ROCKWOOD: Call it four and a half. Now the power if the 600 cubic feet per second of constant flow is maintained will be slightly above 30,000 h.p. continuous power. Now there is an initial investment of $150 per h.p. which is a very high investment. Now that investment cannot be made; that power cannot be created and cannot be operated with any degree of success at all unless the company does get its 600 cubic feet per second. And when the company asks as it now asks—if I construe its application correctly—when it asks for permission to put in its works and then be permitted to take simply what can be taken without affecting navigation, that means simply without affecting the water that comes down stream, without affecting the natural course, when it asks that, it is asking a mere absurdity from a financial standpoint. It is possible that the company has the money to invest without any more assurance of a supply of water than that, and it is possible it is prepared to put in these works without any assurance of having five or six hundred cubic feet all the year round. I don't believe that the money will be put in that on any such basis. If it does come in where do the public authorities stand? They stand in this position: They have given consent to this investment of this 4½ millions of dollars, it would then be claimed, with a sort of guarantee or promise that it would be permitted to earn dividends and a demand, that would be almost irresistible to let the water go through the company's canal regardless of the interests of navigation would be made. At any rate if the company operates with any degree of success at all the stream would be subject to the over-lordship of the Minnesota Canal & Power Company. Now streams and lakes and water-courses are valuable generally in proportion to the quantity of water that flows through them. A large stream is more valuable than a small stream and you cannot take any water away from a stream and have it as big as it was before. You can lead a horse to the bank and let him drink and he is taking infinitesimally such a small quantity of water that you don't know the difference, but there is a difference. But if it is proposed or suggested that six or seven per cent of that water can be taken away from Rainy River and leave just as big as stream and just as good a stream in all respects as it was before, the proposition to my mind—I am not an engineer but a plain citizen—is rather absurd. I cannot conceive how you are going to take away six or seven per cent and have just as much left as you had to begin with. On the hearing before Judge McClennan—the evidence in that case was never printed, but Mr. Banks the Company's engineer who is here to-day testified that he had examined the rapids in Rainy River where the water was most shallow and where the difficulties in navigation occurred, at Potters Point and Long Point taking the velocity over the widest and narrowest points, he has taken the width of the stream and so on and he figured that taking away 210 cubic feet from Birch River would lessen the depth of these rapids in one case a little over two inches and in another case 1·94 inches—approximately two inches in each case. Now two inches is a very important item in navigation. It means hitting the bottom or not hitting it. Two inches is important; the Government sometimes spends millions for a foot and two inches is not an insignificant item. Another thing is true, at many seasons, during many periods in the course of years when the rainfall is light on some other portion of the water-shed it will be heavy on this Birch Lake portion of the water-shed and Birch Lake will be contributed more than 220 cubic feet, more than its minimum at time of low water when it is very much needed, and it is not fair to take that very lowest, that very extreme low estimate of the run-off of Birch Lake watershed and say that it measures the effect on navigation. It might at one moment measure it but at another it would not. It is not fair to take it as a criterion of the whole story. It is not the whole story. This application is addressed to the Secretary of War which is referred to this joint Commission. The question is whether this Commission as a whole—and I suppose the American Section of this Commission will advise the Secretary of War *re* the granting of the permission. I do not believe that any disinterested party can ever think in his own mind that that project can be carried through and enough water diverted from Birch River to make it a success, to make it practicable financially, without destroying the river; that is, without taking all the water in low water and simply letting the surplus run off in times of highwater when it cannot be retained. Of course under these circumstances the company could open its dam and flush down a few logs when some person wanted to take down a number of logs, but there is another lake a little below and if the company flushes into the first lake it cannot flush into the second one until it has raised the water in that second one. It must fill the next one and the next one and the next one. Now certain engineers who are more familiar than I am and understand that better will note down whether I am right or wrong when I assert that this company cannot operate under any plan that its now laid out, under any system of reservoirs of the capacity now contemplated. I assert that it cannot operate and maintain either 600 cubic feet or any other flow that will make its investment profitable without practically destroying in navigation of Birch River and of the streams down to the boundary. Of course as you go on down, the character of the streams becomes larger, the relative effect would be less. While you might take away all the water of Birch Lake and leave that dry you would be taking away seven per cent of the water of Rainy River. As you go on up from the head of Rainy River to Birch River you range between seven and one hundred per cent of the whole. By the way after you reach Rainy River the loss of that water is felt all the way down till you reach the tide-water. That water falls just as many feet in going down one side of the ridge as it does on the other and the water-powers are being improved at the different points. We are improving one on the boundary at Fort Frances. Another has been improved on the Lake of the Woods. One has been improved on the Winnipeg River. There are projects for the improvement of many places. Now that water in going down falls just as many feet and there are many points that are going to be developed on the Canadian and some on the American side that are being developed at the present time and it will perform its full duty of 600 feet ultimately, though perhaps not as promptly. Now aside from the public interest, and it seems to me that it is conceded here that on our side of the boundary the government lacks power to destroy or substantially to affect these public highways. But aside from the public interests there are on both sides the private interests and I want to stop just a moment to call attention to the different ways in which that word "public" is used on our side of the boundary. I do not know whether precisely the same distinctions are made on your side of the boundary or not, but on our side of the boundary we make this distinction that a use is a public use when the whole public or any portion of the public has occasion, has a right in the thing and the right to the use of the thing, itself and in that respect navigation is a public interest, a public use, and really is a public interest because any one of the public who wants to ride on the railway can ride who buys a ticket and gets on and rides the common carrier cannot deny him his right. There are many other public uses that are recognized as such, light and generally those things that affect the public health and so on. Now there is another sense in which the word public is used where the public as a whole has an interest—as in the development of the resources of the company, the growth of the community, the increase in population, the increase and growth of industry and so on—where every member of the public feels an interest and gets a benefit, but has no direct legal right by which he may demand a part of the use of a thing; a store or factory is an example of that kind; the general growth of the community, the business, the industries of the community are illustrations of that sense of the use of the public. Now, when it is asserted a sit has been by Mr. Simonds that the public has no interest in a waterway except with respect to navigation he is using the word public in the rather restricted sense in which we use it on our side with respect to the powers of the government respecting the right of eminent domain, but he is forgetting the other actual interest which the public has in the resources of it s own country. There is the Rainy River country which is affected in the same way. There is a community on each side of the boundary; those men have settled there in reliance upon the growth which would naturally come to that district because of the resources which existed there, and those resources are not alone the soil and the timber that is growing from it, but it is the capacity of Rainy River at this particular spot for the development of water power and for the establishment of industries. Now the whole public—the Canadian and American on both sides of the line, and I represent both—are interested there and when you say to them that a considerable fraction of the water of Rainy River may be taken away over the hill and sent down to Duluth, that you are promoting public interests, they answer you that you are not promoting our use. They want all the resources that have been placed here by nature and on which we have relied when we settled here and we don't want it taken away.

Mr. Simonds: If it should transpire on examination that four-fifths of the water tributary to the Sault St. Mary came from the American side and one-fifth from the Canadian side would you say it would be right for the Canadians to use half of it and the United States half of it?

Mr. Rockwood: So far as that is concerned I understand the law to be—irrespective of any specific provision of treaty, but it is particularly the law by the terms of the Webster-Ashburton treaty—that the centre of the stream is the boundary of this country and Canada. I think that is true of the St. Mary's River. It is not true at all points. Perhaps that general statement is too broad, but it is true unless there are legal circumstances to modify it and that generally speaking, it does not make any difference from which side of the boundary the water comes into the stream. Rainy River is the boundary and the water that is flowing in that stream is naturalized to both countries.

Col. Ernst: You want to get at this particular subject.

Mr. Rockwood: I am speaking of this, that it does not make any difference with reference to this exact situation whether two-thirds of all that water came from one side after it is there. It does not make any difference where it comes from.

Mr. Coste: The boundary is in the river except in some special circumstances.

Mr. Rockwood: Three-quarters of the Lake of the Woods perhaps is on the Canadian side of the boundary, but that does not make any difference with respect to the right of the citizens, the subjects of the two countries, to the use of it and in Rainy River I do not understand that the riparian owner on one shore has any greater right because more than one-half the water comes into the stream above from his side of the boundary. Now I represent both sides so far as ownership of the private property and power at Fort Frances and Koochiching Falls is concerned. The circumstances are these: When these condemnation proceedings were first started the title to the American side was in the Koochiching

Company, of which I am Secretary and of which Mr. G. W. Backus was and is President. Mr. Backus applied to the Government of Ontario and finally made a contract by the terms of which he and his associates were to organize a corporation to improve the Ontario side in connection with the improvement of the Minnesota side so as to develop the power as a whole. The Company has been organized called the Rainy River Improvement Company and that company is engaged in connection with the Corporation called the Minnesota & Ontario Power Co. in constructing a dam across the stream. It has expended a couple of hundred thousand dollars altogether and has made contracts. It has not been proposed yet to make any compensation to the Minnesota & Ontario Power Co. or to Mr. Backus as the owner of the riparian right to the land on the Ontario side for this diversion of water. Of course the damage to that side is just as great as the damage to the Minnesota side. This company demands that it must make compensation in order to proceed at all, must make compensation for the damage to the Minnesota side and it confessed that the condemnation proceedings in it had failed. I suppose they intend to commence against us again. I argued before the District Court and before the Supreme Court that the State of Minnesota had not delegated to the petitioner the right to exercise the power of eminent domain with reference to that situation and one of the reasons that I urged was this, that that was an international boundary, that the courts of the state of Minnesota had no jurisdiction to proceed against any property on the Ontario side.

Mr. Gibbons: Having no power to grant compensation.

Mr. Rockwood: That there was no effort and could be nothing provided to make compensation to that effect on the other side. The reply of the counsel—it was not Mr. Symonds—for the other side, was that it did not make any difference; that if the interests on the Ontario side were legally entitled to damages they must come and sue for damages, but it was argued that we were not entitled to compensation, that these waters were being diverted in Minnesota at a point before they had ever reached the boundary and that neither the Province of Ontario or any property owner in the Province of Ontario had any interest in thêm at that point of development. I cited authorities which I thought were relevant and the Supreme Court cited the same case and it was as stated here on that ground that that Court held that the power of eminent domain had not been delegated to this company for doing the thing which it intended to do. There is no suggestion of any difference among the five judges on that point. Two of the judges said; 'that is probably true,' but they did not again raise that question. That question can only be raised by the state itself in some proceeding in which the state is itself a partner. Judge Elliott answered them by saying that the proceeding had not been authorized; that to do the things which the company proposed to do would be a violation of the law and the Court would not lend its aid toward giving the petitioner any colour of right to do that illegal thing, and that it would listen to our suggestion of the lack of power and illegality and deny the petition. Now that is what it was to them. But confessedly I suppose all those questions are before this tribunal and that is exactly what this Board of Commissioners is created for: to consider these questions where possible interests of one may be adverse to the interests of another on the other side of the boundary and to arrive at a conclusion which will be just and right toward all. It will not, as counsel said—not Mr. Symonds—leave the public interests on the Ontario side to guess what their remedy might be or leave them without a remedy.

Mr. Simonds: Do you mean if this Commission should recommend a permit be given that it should also make a recommendation as taking care of the question of compensation to the parties?

Mr. Rockwood: That question whether this Commission should make recommendations upon that subject had not occurred to me.

Mr. Simonds: Your argument seems to point that way.

Mr. Rockwood: I think my argument if it points to that conclusion points away beyond it and comes to this, that neither our Federal Government nor our State Government has the power. It is utterly lacking in power. Now our Governments of course have the physical power to do what they will on their own side of the boundary regardless of consequences elsewhere, but when our Government disregards the rights of Canada or the Province of Ontario or the private owners or citizens—

Mr. Clinton: The recommendation would have to be carried out by treaty.

Mr. Rockwood: I supposed that that was a subject entirely beyond the jurisdiction of this Commission.

Mr. Gibbons: We can only recommend.

Mr. Rockwood: But if it did recommend what does it come to? It comes to the question whether the Province of Ontario or the Dominion of Canada will sell these resources. Now this is a question that I imagine neither the Canadian Section of this Commission nor the Canadian Government would consider.

Mr. Simonds: They might get compensation elsewhere or in some other place. This is a long boundary.

Mr. Rockwood: I don't know whether there is any proposition pending by which they would consider it. It seems to me that that whole question is entirely outside. I have tried gentlemen to be brief, but I think I have made the statement which covers our view of the case and I think while I have not gone into the detail on some points I think I have suggested the reasons why this petition cannot be entertained. I think there is an expressed prohibition in the Act of Congress. It seems to me that the Secretary of War has expressed the opinion —I have never seen that opinion—but it seems to me he has written a letter in which he stated that he has the power in the Act of Congress to grant power for the diversion of these waters. The language of that Act which is Section 10 of the River and Harbour Acts—

Mr. Gibbons: I don't suppose the Secretary of War has said that.

Col. Ernst: I don't think he has ever written any such letter.

Mr. Rockwood: I have not seen any such letter.

Mr. Simonds: I have a certified copy of it at the hotel.

Mr. Gibbons: I have a copy of it too. This is the language of the Act: 'The creation of any obstruction non affirmatively authorized by Congress to the navigable capacity of any of the waters of the United States is hereby prohibited.'

Col. Ernst: It didn't injure the navigable waters of the United States. It was inappreciable. And for that reason the Secretary of War could in that letter if he chose to give it, be able to grant the permit.

Mr. Gibbons: I don't see how it is possible to arrive at a conclusion. While I appreciate the purpose of Major Derby in trying to find a solution that would enable all parties that were before him to do what they were seeking to do, it seems to me that it is utterly impracticable. It seems to me when 500 or 600 cubic feet are taken away from a running river it is not going to be as big as it was before. He is only dealing with the question of navigation.

Mr. SIMONDS: It would not be as big, but it might not be as big at all points and at all times when its capacity was undisturbed.

Mr. ROCKWOOD: The capacity of water for navigation, is not its present state, it is not its highest or lowest depth now, but it is the greatest that can be created by mankind, that is feasible or available—the quantity of water that naturally flows there and the means of storage that exist on the watershed. This contract that we have made for the improvement of the power with the Ontario Government requires that we shall develop the capacity of that stream so far as practicable by utilizing the means of storage on the watershed and creating the watershed.

Col. ERNST: What quantity of water do you propose to use there?

Mr. ROCKWOOD: We propose to use all there is, but we don't know just how much.

Col. ERNST: You haven't made your plans?

Mr. ROCKWOOD: We have made the plans for an initial development of 20,000 horse power. The quantity of water in the lowest flow that we have discovered is about 3,500 cubic feet.

Col. ERNST: 20,000 horse power?

Mr. ROCKWOOD: That is a minimum.

Col. ERNST: Do you mean that you would use 3,500 cubic feet a second to develop 20,000 horse power?

Mr. ROCKWOOD: A good deal more. 3,500 feet will not develop 30,000. It will take 7,000 or 8,000.

Mr. COSTE: You are going to increase the flow of Rainy Lake by storage.

Mr. ROCKWOOD: Yes. Rainy Lake itself is controlled by Rainy River. It can be raised perhaps four feet.

Mr. COSTE: Since you can do that, if you can increase the flow in the Rainy River, if you can distribute the water better, why couldn't they do the same thing?

Mr. ROCKWOOD: They could do the same thing, but the way it happens it belongs still, as a matter of fact, to Rainy River.

Mr. COSTE: There is such a thing as having too much water at one time and not enough at another.

Mr. ROCKWOOD: That is true, but the way to prevent having too much is to hold back the flood water by storage.

Mr. COSTE: And keep it in the system to which it belongs.

Mr. ROCKWOOD: That is it exactly.

Mr. COSTE: Even then you may have too much.

Mr. ROCKWOOD: There may too much for one day or two a week. But then there is never too much. There will not be enough unless there is sufficient storage capacity in the drainage basin so as to impound the flood waters at their highest in storage and control their discharge. Now it happens that the drainage basin of Rainy River is filled with its storage basins from one side to the other. It lies up in that rocky region which Mr. Simonds describes. Our plan is to go ahead and develop and improve these storage basins with the idea of... ....

Mr. **Coste**: Your idea is that Rainy River cannot support the two developments.

Mr. **Rockwood**: That is it exactly. Now we would be glad if Mr. Simonds could have it too.

Mr. **Coste**: Isn't it a fact that you are going to waste the water all the same at Fort Frances.

Mr. **Rockwood**: We don't know that it will ever be able to reach a point where no water will be wasted. But if the Birch Lake reservoir is turned over to the use of the St. Louis river we are deprived of that. That is ours.

Mr. **Coste**: You might find that this position would be a help to you instead of being a detriment to you if you found that you have too much water in your reservoir and cannot store it without tremendous expense.

Mr. **Rockwood**: It would never help us; it means that they would be sending the water toward Duluth. It would help us if it was only sent down towards us that way.

Mr. **Simonds**: Perhaps you would like to have us do that for you.

Mr. **Rockwood**: If you offer it we will treat your offer courteously. My point is this. If it is used to divert water to the St. Louis River then we will get that surplus when we don't want it and in periods of low flow it may be in the interests of the Minnesota Canal & Power Company not to allow us to have a drop and if that situation were once created it would never be so effectively controlled by any Government as not to do harm to us and to similar interests which we represent on the boundary.

Mr. **Coste**: They propose to impound 20 times the amount of water that they shall require annually.

Mr. **Simonds**: No, we wish to use if we say 600 cubic feet about 18,000,000 cubic feet in the year. Last year there were about 42,000,000 cubic feet that ran off that watershed. And now about the matter of storage. I said to you that we had measured up about 10,000,000,000 cubic feet of storage. We have done less than that. We have explored about 15,000,000,000 feet of storage that we have not measured up. We have not got through with the business. It is too early to put too much labour and money into that view of the matter, but we could store all we would use in the year so that with a year's reservoir full we could let the whole flow go.

Mr. **Coste**: You would have a supply of 20 years there.

Mr. **Simonds**: No.

Mr. **Coste**: If you impound 20,000,000,000 cubic feet of water and use 3,000,000,000 a year.

Mr. **Simonds**: No, we use about 18,900,000,000. We could make a year's storage.

Mr. **Simonds**: I don't wish to reply to anything which Mr. Rockwood has said.

Mr. **Gibbons**: I think it would be well if your engineer could give us a clear and distinct account now of what is proposed to be done.

Mr. **Simonds**: We shall be very glad to have him do it. We brought him here for that purpose.

Mr. **Lazarus Silverman**, representing the Enterprise Iron and Land Company, addressed the Commission as follows:

I certainly am proud to be here before a Commission representing the greatest nations on the face of the earth although the subject before them is not of such great importance. Mr. Simonds and his Power Company went to the State Courts and asked permission on the eminent domain law to do certain things. The Court said that the eminent domain law is created for the purpose, for example, if a railroad is to be built and someone owns a piece of land and refuses to sell it or refuses to take a fair price for it, that the law shall step in and fix the price for that land. If a canal is to be built and some man owns a piece of land and refuses to sell it the eminent domain law is made for the purpose of compelling that man to sell that piece of land. The Supreme Court of the State of Minnesota decided that he is not entitled as set forth in his petition to divert water or condemn land because the eminent domain law was intended for an entirely different purpose than the diversion of waters. Then he comes before this Honourable Commission and says, 'Help us out and give us something the State won't give us; we want the water rights.' Who do they belong to, Mr. Simonds, to you? No, they belong to the people that live in the community. Duluth is fortunate in having something like 40,000 horse power to use. More than ten years ago I as President of our Corporation, which owns those lands, had surveys made for the purpose of utilizing this fall for electrical purposes. I went even so far as to get the officers of the General Electric Company to go on the ground and make surveys and look over it, the practicability of it. I had the well known engineer, Mr. Johnston, of Chicago, who has built electrical works throughout the United States in various places, go over the ground and find out where the water should be stored and find how much water would be there in dry seasons, to find out how much water would be there in dry seasons, to find out how much water could be maintained there for the purpose of even flow of water all the year round. But I found to my great sorrow a lawsuit—this corporation having for the last 10 years against that land and my next door neighbour who has a small power plant, a petition in Duluth. I want to get this thing disposed of. It is of damage to me. I want to use my land. They simply say we will take your land out. We don't want to be dismissed; we want to fight it out. We want to get this question disposed of—it is simply a blackmail. We cannot use our property for the purpose which we desire. The City of Tower has about 7,000 inhabitants, Ely has 3,500 and Winton has 2,500 inhabitants. Each one of these towns is entitled to the benefits of that water fall which nature gives them. They have now to bring their coal 700 miles to create electrical power. They have iron mills there. We are shut off from using that power for the benefit of those people just as well as if it never existed. Look at the injustice. Some men that has no rights in it file a blackmail suit there and which we have tried to get rid of for the last ten years but without success, and he comes here today and asks the United States to help him out. What was done? A Commission was appointed by the United States to find out whether those waters are navigable waters of the United States or not. The Commission reported, they are navigable waters of the United States. According to the law of the land navigable waters of the United States cannot be diverted. That is the law. But it seems Congress has left a loophole open in case of necessity, where the whole nation is suffering, where great damage is being done if certain waters are not diverted, but I say that requires an Act of Congress; it requires the recommendation of the highest official in the United States next to the President; it requires the Secretary of the Interior's consent. Is this left open for the purpose of giving some person something which does not belong to him? It is left open for some occasion when it would be in the interests of the people of the United States to have the waters diverted. When I come to the people of Ely and Tower they are all anxious to have the water. They are not willing to sell this land and the advantage which they have to be given to

Duluth. I also know people whom I represent that own land that has iron in it and they want to utilize every horse power there; and now comes an enterprise which says because this is a good thing I am going to take it away from you. They have got no right to take from those 14,000 people their rights. The trial Court in the State of Minnesota decided, You have no right to condemn those lands. You do not build canals for the people. You build a Canal but you have no right to cut it through the hills and take the water to Duluth. Duluth gets 40,000 horse power. They don't want that. But at Ely, Tower and Winton where we own it we are entitled to it. They can buy their power for light, for pumping, for running their industries, for taking iron out of the mines at one quarter of whatever they are paying now through having to haul their coal a distance of 700 or 800 miles. Now here is a Commission appointed by two of the greatest nations of the earth to do what? To decide whether that man who has no more rights than an ordinary citizen to take something which does not belong to him can come to the United States and say because the State won't give it to me I want you to help me out. I feel proud to be before you. I am not talking to you on matters of law and boundary lines, but there is one thing which I can say to you. If on the recommendation of the Engineers of the United States that this thing could possibly be done if they take water away from Canada they must come and restore that much water. I hope that this High Commission of men that want to do right, that don't want to throw obstacles in the way, that don't want to say to the United States go and divert the waters against the laws of Nations and against the laws of your neighbours—what man is there that can see what damage such an intrusion will have in the future where hundreds of streams between Canada and the United States and the United States and Mexico flow one way, and if the United States sets the example of breaking those laws because they are powerful they must be willing that the other nations should do the same. If the United States could it does not break laws, a nation that has given hundreds of millions of dollars and thousands of men for the purpose of driving out an enemy which is unpleasant to this country and say to that neighbour, the little republic, we not only have driven your enemy away but hundreds of millions of dollars have been spent and thousands of lives have been spent—we give it to you—that Government does not make contracts to please any man or a thousand men. That Government stands ready to render its best services to the land, as does its neighbour Great Britain—they are closely connected. Should any man be base enough to say I ask you to break your contract with your neighbours they would not notice it.

Mr. Coste: What prevents you from developing your power?

Mr. Silverman: Because the eminent domain bill stood against it. If the water is taken away we have no power.

Mr. Coste: The Company is not chartered is it?

Mr. Silverman: Yes, but they come in under the law of eminent domain to take our water away.

Mr. Simonds: We have the papers of the Minnesota Canal & Power Company relating to that portion of the country that Mr. Silverman is interested in and which were filed in 1904.

Mr. Silverman: When were your papers filed first, 10 years ago?

Mr. Simonds: No. February, 1904.

Mr. Silverman: 1904 was simply a reinstatement of the old.

Mr. Gibbons: I suppose that is all.

Mr. Simonds: It is not pertaining to the case.

SUBSTANCE OF TESTIMONY GIVEN BY MR. E. B. BANKS, ENGINEER OF THE MINNESOTA CANAL & POWER COMPANY.

The original petition of this Company sets forth that the mean precipitation on the Birch Lake Basin was 30″ per annum, and that the run-off would be not less than 40% of same or a yearly run-off of 30,666,000,000 cubic feet. This statement of precipitation was based on over 32 years reports of the United States Weather Bureau at Duluth and 8 years Tower, Minnesota Tower being the nearest point to the Birch Lake basin at which such records were available. We find, however, that the run-off has been under estimated. Since May 1st, 1905, the Company has kept a daily record of the flow from this basin and the precipitation on same. This record shows that from May 1st 1905 to May 1st 1906, the precipitation on said basin was 32·25 or 107% of the assumed normal precipitation. This is equal to 82,415,520,000 cubic feet. The run-off during this period actually measured by a price-current meter, was 42,334,000,000 cubic feet, which is equal to 51·4% of the precipitation. If we assume that during said period the Minnesota Canal & Power Company had drawn 600 cubic feet per second from the Birch Lake basin the total amount diverted would have been 18,900,000,000 cubic feet, or 44·6% of the flow. From a careful study of this and similar water-sheds I am able to construct a run-off curve for this basin, which will show approximately the flow that may be expected during the years of varying precipitation. This curve is adapted from Newells' run-off curves so called, which gives us the best information obtainable on this subject. From this curve I deduce that during a year of normal precipitation, (that is 30″) we may expect a run-off of 34,527,000,000 cubic feet. Now if we should divert 500 cubic feet per second or 18,0000,000 cubic feet per year, we would in effect reduce the area tributary to the boundary waters 600 square mile, and the percentage of diversion from the several lakes along said boundary together with the drainage area tributary to same will be shown on the following table:—

Lake.	Drainage Area above outlet.		Per cent diverted.
Birch	1,100	Sq. miles.	54,5
Basswood	1,738	"	34,5
Crooked	1,966	"	30,5
Lac La Croix	4,557	"	13,1
Namakan	6,991	"	8,6
Rainy	17,000	"	3,5
Lake of the Woods	28,228	"	2.1

In the showing of the Minnesota Canal & Power Co., before Majors Derby & Potter on pages 7, 8, 9 and 10 will be found a careful discussion of the effect of diverting 220 and 600 cubic feet respectively from the Rainy River at Pithers Point and at the Manitou and Long Sault Rapids. On pages 11, 12, 13 and 14 will be found a discussion of the effect of said diversion on the Lake of the Woods. I wish also to call your attention to pages 27, 28, 29 and 30 and 31 of said showing in which the question of compensating reservoirs are considered. The reservoir capacity within the limits of the Birch Lake basin and along the water way connecting same with the proposed power house, which can be made available for use will store more than 18,000,000,000 cu. ft. which will supply the power-plant for one year without the diversion of one drop of water from the Birch Lake basin.

This is stated on page 48 of this showing before the United States engineers.

Mr. Rockwood made the statement that the past four or five years had been years of more than average precipitation. This statement is not substantiated by the records of the United States weather bureau as given on page 43 of said showing. Mr. Rockwood stated that the proposed plant of the Minnesota Canal and Power Company would cost $150·00 per horse-power. This is not correct. As a matter of fact the hydraulic installation contemplated is not less than 60 thousand horse power. Hydro-electric plants are rated on the basis of their hydraulic installation. The load on such plants is variable and the hydraulic installation must be sufficient to take care of the peak or maximum load. If we assume an average flow of 600 cu. ft. per second under 600 ft. net head we will have a continuous output of about thirty-three thousand horse-power. Assuming a loadfactor of fifty per cent which is a fair and reasonable assumption the required hydraulic installation would be sixty-six thousand horse-power which would be the rated capacity of the plant and the basis for calculating the initial cost per horse-power. Our estimate of the cost of the plant including the generation and transmission of the current is Four Million Five Hundred Thousand Dollars ($4,500,000) or about $68 per horse-power. If we deduct the cost of electrical generation and transmission, the cost of hydraulic power at the power-house will be reduced to $50 per horse power which is much below the average cost for hydro-electric plant in the United States and Canada.

Mr. Banks: Mr. Rockwood has stated that the flood water that passes over from Birch Lake will come down there during the flood stage at Koochiching, but it won't do any such thing. It is 155 miles from Birch Lake to Koochiching and the flood flow at Koochiching will be gone by many days.

Mr. Simonds: When do you expect you will have to take up your waters?

Mr. Banks: We will get a large amount off during April, May and June.

Mr. Gibbons: You made those suggestions which were embodied in their report?

Mr. Banks: No I don't think so.

Col. Ernst: After that you made the surveys?

Mr. Banks: I made surveys of all those dams.

Mr. Coste: When does the water reach its lowest stage in Rainy River?

Mr. Banks: In March and April.

Col. Ernst: Can you tell what pamphlet that is in?

Mr. Banks: It is in that application to the War Department, in the back part of it.

Mr. Gibbons: What do you say Mr. Simonds as to what you propose as to compensation?

Mr. Simonds: I have not gone into that question but we expect if a man is entitled to legal compensation to pay him. But we have no expectation of paying the Canadian Government or a body of its people for their expectations of its growth and development. We do not suppose that was a matter which could be put into dollars and cents.

Mr. Gibbons: You recognize the right of the Ontario side at Fort Frances, to that Power Company.

Mr. Simonds: We do. When we finally get into a settlement with Mr. Rockwood what other damages he can prove that his company is entitled to, that is without reference to the State's, we will pay.

Mr. Gibbons: I am afraid the rest of the public would have a hard time.

Mr. Simonds: If we have no money after settling with Mr. Rockwood. I don't know what his latest claim is. His last was $50,000.

Mr. Rockwood: It would be a great deal more than that. That was before any money had been spent.

Mr. Gibbons: I don't think it is a question of the settlement of private interests in this matter at all.

Col. Ernst: Is there any ground for this doubt which has been raised on the quantity of water they propose to take, 600 cubic feet, if you changed your plans in that respect?

Mr. Coste: It may take more.

Mr. Simonds: I want to make it clearly understood about that.

Mr. Banks: I would like to say right here that we propose to have storage enough so that we can do business and provide for all other fixed incidentals and presuming that the mean precipitation is thirty inches we will get a run-off from that of something like 35 billion cubic feet; that our storage will be sufficient to tide us over any small year, any year of small precipitation.

Col.Ernst: What will be the consumption?

Mr. Banks: We have always figured on 18 billion.

Mr. Coste: You will have a capacity of 1,100 feet canal and works.

Mr. Banks: Our pipe line will be constructed to carry 1,100 feet per second, but only from the forebay down. We have a large reservoir on our canal which holds nearly one billion cubic feet which would take care of any over load.

Mr. Simonds: We want permission to take all the water that we can get that will not interfere with the interests of navigation.

Mr. Gibbons: You do not include in public use riparian right.

Mr. Simonds: That you will take care of personally. But so far as the public is concerned we concede that the public is entitled to the use of this water for navigation or any other public purpose and we propose to use that in such a manner as not to interfere with the public use nor to lessen the capacity for navigation, and what we take will be subordinate to that prior claim of the public; is that understood?

Mr. Gibbons: That does not get out of the difficulty. For instance the Ontario Government has a right to this water here; that is a public use.

Mr. Simonds: What I mean by a public use—I made no preparation for coming here; as a matter of fact I got a telegram and came on—what I mean by public use I mean such use as the courts of the United States or of Minnesota recognise as a public use of waters and principally navigation. There may be other possible public uses to the stream and the State should protect and whatever they are we must subordinate ourselves to them. I speak of navigation as that is an overwhelming interest. If we injure Mr. Silverman we have got to pay him.

Mr. Gibbons: Have you got the right to injure him?

Mr. Banks: We have got the right to injure him I suppose if it would injure his property by our works and operation he would have a cause of action.

Mr. Gibbons: That is not so.

Mr. Simonds: Irrespective of the condemnation proceedings I do not quite see how you can injure another man's property without creating a cause of action.

Mr. Gibbons: You can by the State authorities. If you get authority from the State on their own lands I don't see how the people in the Province of Ontario would have any right to get damages.

Mr. Simonds: I don't know. But it seems to me that what we get from the State is a consent that is guarded with reference to the interests of navigation.

Mr. Clinton: That does not cover the proposition at all. It is not a question before this Commission as to whether the citizens of Ontario should be paid for their private injury or not. It is a question as to the policy to be pursued.

Mr. Gibbons: I quite understand. All these things are part of the policy. I want to see how the effect is going to be. We are trying to get some principle that will act with regard to all these waterways. In the event that we could divert water in navigable streams the effect of that farther west would be to destroy private rights in Oregon or elsewhere; that is a material consideration. We cannot shut our eyes to each other.

Mr. Clinton: The policy of the law under eminent domain proceedings has always been adverse to the condemnation of private properties or rights leaving the party injured to his legal right of action.

Mr. Simonds: It is within my general knowledge that the people of the United States have in one way or another so diverted the waters of the Rio Grande River that a claim has arisen on the part of Mexico against the United States for damages. That was referred to a commission and that matter has been threshed out and I believe a treaty has been prepared between the two countries by which a settlement of that question has been made.

Mr. Clinton: I don't think it is consummated.

Mr. Simonds: I don't know whether it is consummated or not. I do not like to have you gentlemen dignify the diversion of a few hundred feet of water from a water-shed of the magnitude of this.

Mr. Gibbons: The probability of it is the same principle I suppose as will have to be applied everywhere. I don't see how we can adopt your suggestion at all to give away rights here and then try and get your people to give other rights to its equivalent. You have got to adopt some principle and then apply it all the way along the line.

Col. Ernst: Your idea is that the United States should pay Canada for the damage; is that your idea?

Mr. Simonds: I suppose that is the idea. That is the way it was done in Mexico. Is that the way Mr. Clinton?

Mr. Clinton: I don't know.

Mr. Rockwood: I think Mr. Chairman that it will be very apparent to engineers that these estimates that are given are necessarily only estimates, they are given as estimates, and that it certainly would not be at all fair to take a year of as heavy a rainfall as we have had during the past year in the North West. This is the fifth year now that we have had a rain fall considerably above the normal. It would not be fair to take any investigation or series of statistics extending over any portion of that period and say that is a safe basis for a series of years in the future or particularly for the dry years that are sure to come. Now I think also that it would be apparent to engineers that it would not be safe in a matter of this importance to act on any ex-parti investigation. I do not wish to cast any reflections on Mr. Bank's ability or good faith, but this is a question of a good deal of importance to those who are interested in it and I do not believe that this commission ever ought to recommend an action that is based on figures drawn from a very narrow basis of statistics that are presented here. I do not know of an instance where nations have entered into negotiations in advance looking to a compulsory submission on the part of citizens of one to the payment of damages to injuries to be done in the future by the citizens or subjects of another. If the injury has occurred and is inevitable in a sense then they go into the question of compensation and doing justice as nearly as may be done. But here are hundreds of miles of water from the point where these waters strike the boundary where there is going to be more or less damage at many points, damage to private property interests saying nothing about damage to both classes of public interests that have been referred to. Now it is simply entering upon a ground that is entirely speculative as to what the amount of these damages will be; who is coming forward to make the claims and what they will be able to establish, and here is a corporation not offering any security and which a few months ago had no asset whatever. They may have some now.

Mr. Simonds: They have funds to meet obligations.

Mr. Rockwood: You have no obligations. In proceedings of eminent domain against a property owner you are compelled to put up the money before you step in and appropriate anything. Here as I understand you propose to appropriate and leave us the chance of coming and suing you and proving our damages and then to the chance of collection. Now the interests on the Canadian side which I represent object very seriously to be put in any situation. The courts have no power if they would to assess these damages in advance and we do not want to be situated where we must sue and take our chances with the uncertainties of the law, the uncertainties of findings and the uncertainties of collection if we ever did get a verdict. As Mr. Silverman has spoken we think we have been held up long enough with these proceedings pending. They are a detriment. Our situation is one in which no property owner likes to be, where a big company may take his property away from him against his will and to submit to such compensation as he may be able to get. I don't think it is fair. We have gone so far and the Supreme Court has said that you have no power—the five judges agree that they have no lawful right to take it. The law in that particular has not been changed at all. We have not complained at all to your proceeding to the end of that rope, but having reached the end of that rope we do not think it is fair to continue the proceedings indefinitely.

Col. Ernst: We will be in executive session to-morrow.

Mr. Simonds ; All I was going to say to-night was that Mr. Rockwood is such a poor engineer when he goes to talk about engineering propositions that you have to keep watch of him all the time. What Mr. Banks read from was a diagram prepared by him from what is known as Newell's run-off curves with which I suppose all engineers here are familiar. That is not a matter of one year or ten years' experience.

Mr. Rockwood ; I didn't question that rule at all. What I questioned was the statistics with reference to the water-fall in this particular water-shed. I was going to ask whether the documents that have been submitted there are interests in Duluth which I know desire to be heard from and they have no practical opportunity to be heard at all and I want to ask to be permitted to take a list of the documents that are in the record and to submit in writing a reply to them if I think there ought to be within some limited time.

Col. Ernst : With regard to these gentlemen in Duluth, I think it is a matter of their own convenience. I do not take any stock in that plea of having no time. They were notified on the 28th May. If they are not here that is their own fault. Still we may find that we wish to hear from them ; in that case they can communicate to us in writing, but that must be a matter of decision in to-morrow's meeting. My idea Mr. Chairman is that the public hearing closes to-day unless you wish to open another one.

Mr. Gibbons : Subject to what I suggested to you about the desirability of having Canadian interest represented who had not notice. Of course they were not aware of this at all.

Col. Ernst : So far as those people who had been notified the hearing is closed.

LIST OF DOCUMENTS, PLANS, BLUE-PRINTS AND PHOTOGRAPHS FILED IN THE HANDS OF THE SECRETARIES OF THE TWO SECTIONS AT THE PUBLIC HEARING HELD BY THE INTERNATIONAL WATERWAYS COMMISSION ON TUESDAY AFTERNOON THE 5TH OF JUNE, 1906.

1. The petition of the Minnesota Canal and Power Company filed in the District Court of the 11th Judicial District of the County of St. Louis, in the State of Minnesota, dated May 10, 1906.
2. Copy of the opinion of the Supreme Court of the State of Minnesota in the case of the Minnesota Canal and Power Company against the Koochiching Company.
3. A printed pamphlet containing (*a*) the application of the Minnesota Canal and Power Company of Duluth, Minn., for the recommendation of the Chief of Engineers and the authority of the Secretary of War to divert a portion of the waters of the Birch Lake Drainage Basin into the St. Louis River, and thereafter the same amount of water from said St. Louis River into applicant's St. Louis River canal, and for the approval of location and plans of the dams and structures necessary to effect such diversion, dated March 25, 1905 ; (*b*) exhibit "E" of the Department of the Interior, General Land Office, being the reply by applicant to protests and proofs in support of reply ; (*c*) exhibit "F" of the Department of the Interior, General Land Office, showing of Applicant before Majors George McC. Derby and Chs. L. Potter of the Corps of Engineers, United States Army.
4. Petition of the Minnesota Canal and Power Company in the District Court of the 11th Judicial District of the County of St. Louis in the State of Minnesota, dated Feb. 25, 1904.
5. A general map marked No. 6-A, showing the proposed works of the Minnesota Canal and Power Company.
6. Photographs showing the Keewatin dam at Rat Portage, Ont. and also the stop blocks ready for use.

7. The run-off diagram of the Birch Lake Basin adapted from Newell's run-off curves.

8. A map marked No. 8 showing part of the Birch Lake Drainage Basin and the Waterways connecting the Kawishiwi River with Fall Lake.

9. A map marked No. 9 being a profile showing the Waterways connecting Kawishiwi River with Fall Lake, in Lake County, Minn.

10. A map marked No. 11, being a profile showing the Waterways connecting Birch Lake, in Lake County, Minn., with the Lake of the Woods.

11. A blue-print showing the stages of water at the Keewatin dam.

12. A blue-print showing the dam across the main outlet of Lake of the Woods near Rat Portage, Ont., known as the Keewatin dam.

13. A map of the north end of Lake of the Woods showing the several outlets to said Lake and the waterpowers located thereon.

14. A map marked No. 17, being a plan of the proposed dam across the Isabelle River.

15. A map marked No. 12 showing the profile of a proposed dam across the outlet of Birch Lake.

16. A map marked No. 14 showing plan of the proposed controlling dam across the westerly end of the St. Louis River canal.

17. A map marked No. 16 showing the profile of the proposed dam across the north Kawishiwi River in Lake County, Minnesota.

Public Hearing on the application of the Minnesota Canal and Power Company on June 26, 1906, in Buffalo, N.Y., presided over by Brig. Gen. O. H. Ernst, Chairman of the American Section, and to which the full Commission was present.

Chairman Ernst: Col. Anderson, Chief Engineer of the Department of Marine and Fisheries of Canada, is here, and I understand, Col. Anderson, you desire to address the Commission on two subjects, the Chicago Drainage Canal, and also the Minnesota Canal and Power Company.

Col. Anderson: I was not aware that I wanted to address the Commission on either of those subjects. I simply am here to furnish any information which our Department has on that subject.

Chairman Ernst: You are not prepared to volunteer any information.

Col. Anderson: I haven't very much to say on either of those subjects. I prepared no brief on them.

Chairman Ernst: Then you do not care to address us?

Col. Anderson: You are taking up that Rainy River question?

Chairman Ernst: Yes.

Col. Anderson: I should like to point out regarding that, that it is a matter that seriously affects the Canadian navigation on the Lake of the Woods and Rainy River; I do not think it affects American vessels to any extent. All the Canadian traffic runs to Rat Portage and through the Lake of the Woods and there is a very large traffic developed there and it is the only means of ingress to Rainy Lake that we have got, is up the Rainy River. Now, there is no difficulty in the Lake of the Woods, there is always sufficient depth there, and in the lower part of Rainy River there is sufficient depth; but as you get up to the rapids it becomes very shallow, and towards the close of the season it is necessary to take off the boats that have a larger draft, and take the shallow boats; and it is quite obvious if any water is diverted from that river, from the upper part of that river, it will altogether prevent navigation in the summer season; and the matter has been considered so important by our department that we have made recommendations to your Department of State in the matter, and I think probably it is through those representations that the matter has come before your Commission. We have done a great deal in the way of putting in beacons and removing rocks and improving the channel, but all that work will be absolutely void if there is any diminution in the stream. It is as much as shallow draft boats can do now to get up the Rainy River, and there is a large settlement and it is the only means of access to the whole of that country, and if any diminution of water occurs it will absolutely stop navigation; therefore my department would urge your Commission to prevent the diversion of the water.

Chairman Ernst: Mr. J. G. Sing of the Department of Public Works of Canada is here. Mr. Sing do you desire to be heard on the same subject?

Mr. J. G. Sing: Mr. Chairman and gentlemen, I did not know exactly what was required of me when I received the notice to be here. Last year I was called upon to report on the power development. I went and made an exhaustive investigation into the power development and reported to the department. I have a copy of that report here. Of course then there was no question came up as to any diversion of the water or any diminution of any kind.

I heartily concur in what Col. Anderson has said as to the result if the water was diverted in any way from the Rainy River. The flow of the river at the Falls varies from thirty thousand to forty-six thousand cubic feet per second, and if you divert the water across the height of land in any other direction,—the height of land occurs about forty miles from Lake Superior, and the Rainy River practically drains that country through various small lakes and connections. The power company proposes, so I was informed, to build a number of subsidiary dams on the various streams tributary to Rainy Lake and the Rainy River, and of course if that were done and there was any diversion made up further, it would practically put them out of business.

There are a number of vessels, as the Colonel has remarked, plying out of Fort Frances, out of Kenora, to Fort Frances. Here is a list of those: The Kingfisher, 76 tons; Mather, 144 tons, length 87 feet; Ethel Banning, 37 tons; Brandon, 176 tons; Kenora, 486 tons; Keewatin, 81 tons; the Empress, 129 tons. Now, the Kenora is a large boat and an expensive boat and is built for the purpose of trading between those two points and carrying freight and passengers, and it would result very disastrously.

Commissioner Coste: How far does the Kenora go?

Mr. Sing: It cannot go, in low water I do not think she has gone up above the Long Sault.

The Big Turtle River has an average width of about 132 feet, and an average depth of three feet.

On Seine River is Alice A. Falls, with a head of 24 feet six inches, which will develop actual horse power of about 6,200. Height above sea level, 817 feet. They propose to distribute the power there for about 22 miles. They propose spending about five hundred thousand dollars. The river has a discharge at low water of about two thousand cubic feet per second. The Minadoa River flows into Rainy Lake. This would be one of the streams that would be affected.

North-west Bay River also draining into Rainy Lake has a flow of about one-fourth of the Seine. Kettle Falls, which is the outlet of Namakan Lake, is somewhat larger than the Seine. These waters lie partially in Minnesota and partially in Ontario.

I could leave my report, if it would be of any use to the Commission. I do not know as it deals with this question particularly; it is more in connection with the progress of the work and the conditions I found the work in and what I considered necessary there in order to protect the town of Fort Frances from flooding; but it would certainly be very detrimental and very serious indeed if there was any diversion of waters above the Falls from their natural flow. I could not give you the difference between the extreme high water and low water, but it is very considerable there in the river at Fort Frances. I have Fanning's report for the Minnesota Power Company; it deals with the thing there very explicitly. If it is the desire of the Commission, I would prepare a statement and furnish it to you later on. I haven't had time to go into it. I am very busy in connection with my other duties of the department. I will undertake to do that if you desire it.

Chairman ERNST: We were in hopes you would be able to make a full statement today, Mr. Sing, but of course the Commission does not desire to shut you off in any way. How long would it take you to prepare such a statement?

Mr. SING: There is a lot of information that I could secure from the Ontario government; they have made an examination and cross-sections of nearly every stream navigable in the neighborhood. Of course that I haven't done; it would be a matter of compilation, going over records; their department since this water power question has become so prominent have sent out engineers to make those, and that information would have to be acquired.

Chairman ERNST: How would that bear upon this question exactly?

Mr. SING: It would give you the size of all these streams and enable you to see at once how it would affect it.

Chairman ERNST: You mean the Rainy River?

Mr. SING: Yes, exactly; where it is proposed to build these subsidiary dams of these various streams mentioned.

Chairman ERNST : Any facts that would substantiate that opinion.

Commissioner CLINTON : How long would it take you to get the information and make the compilation?

Mr. SING : It should not take a great while ; perhaps two weeks.

Commissioner GIBBONS : Then suppose we leave it that anything Mr. Sing can give us within two weeks will be very gratefully received.

Chairman ERNST : Yes, I have no objection to that.

Mr. FLAGLER : It seems to me, Mr. Chairman, that the protestants in this matter of the diversion of water have come in here at the eleventh hour after having hung up this thing for fourteen months upon the request of the British Ambassador, and this Commission is asked to wait two weeks, and at the end of that some other gentlemen will come in. I think in fairness to us that there should be a limit put to the length of the time,—not that we wish to shut out any evidence, but the mere opinion of a gentleman who comes here and tells us that it is going to seriously interfere with the navigation of that stream, with nothing to back it, after fourteen or fifteen months' time to prepare themselves, is asking for a good deal, to wait two weeks.

Chairman ERNST : The question has already been decided by the Commission, they decide to give the gentlemen two weeks to hand in a written statement of the facts.

Mr. O. H. Simonds : I received notice that the gentlemen might be here, and I came. There is some misapprehension I think prevailing in relation to it and I think we can elucidate some of the matters, to bring the matter down to the thing to be considered. These gentlemen agree that the only portion of the international waterway that could be deemed to be affected by any diversion, any reasonable diversion, is a distance of about forty-five miles between the Long Sault Rapids in Rainy Lake, and Fort Frances ; and, as a matter of fact, that might be cut down to the Long Sault Rapids itself, which constitutes a dam for the holding back of water above it ; below that the water is backed up by the stop logs, as stated, in the Lake of the Woods. Now, the gentleman who last addressed the commission, whose name I did not hear, refers to a class of diversions which are not involved that I am aware of in these proceedings, and I would like to state for his information in whatever he may have to do hereafter, that I understand that all the rivers that he has mentioned there are solely in Canadian territory ; they reach Rainy Lake and Rainy River from the Canadian side, all except Lake Namakan. The only diversion proposed by the Minnesota Power Company is the diversion of what is known as the Birch Lake Drainage Basin, or the portion of it located in the State of Minnesota, and the only dams that are proposed, aside from those diversion dams, are dams suggested by the officers of the War Department for the purpose of storing up flood waters, to be let down under the direction of the War Department of the United States, for the purpose of remedying the flood difficulties which both of these gentlemen have referred to ; so that I would be glad to get information as to the flowage of these other streams. Whether it is material, is not for me to say.

The first gentleman who addressed you spoke about Rainy River being the only means of transportation to Rainy Lake. I suppose he meant the only lake or river transportation ; he did not mean to exclude the railway transportation which is parallel to Rainy River for its entire length from the Lake of the Woods to Fort Frances. What he says would have been correct prior to the opening of the Canadian Northern Railroad, which opened in 1902 and has been in operation since. I think the records of the Canadian offices will show that the tonnage and business upon that lake has declined since that time on account of the service which the railroad renders. You understand that business must be mainly local because none of these waters reach any important commercial centre. Now, while that is nothing to us, and while we recognize whatever obligations we owe to navigation, yet I would not like to have the Commission go away with the impression that any effect upon navigation should be to shut those people out from the world, because that would not be the case at the present time.

Then, the amount of diversion that is proposed : while it is not definite and is subject to navigation interests, get the amount that has been calculated upon that might be taken without detriment to public interest is six hundred feet a second.

When I addressed the Commission before, the then Chairman of the Commission asked me some questions that I couldn't answer. I have since answered them in a brief which I have filed with the Commission, and the attitude taken in that brief is the attitude that I wish to be understood as taking now, and that is, that we do not recognize the right of any country upon any streams which originate in the United States, until they reach the boundary waters ; in other words, it would be possible, I think, to divert every drop of the Birch Lake Drainage Basin without incurring any responsibility to Canada or without incurring any responsibility or infringing in any respect the legal rights of any riparian owner upon the Canadian stream. I think that if the Dominion of Canada or anyone under its authority should divert water from these boundary waters, anyone on the American side affected by it would have no remedy ; in other words, he has no interest or right in the stream itself so long as it is within Canadian territory, and it is only when it reaches boundary waters that international questions can arise ; this would be true for every purpose, for its effect upon navigation and for its effect upon any private or other use.

Mr. Rockwood when he was here asked the question as to how we were going to compensate the Canadian end of his water power, and that was not answered any better than the other was, but this position answers that question; that is the answer which we make to that question. In the absence of treaty relations we had no interest in the streams of Canada and Canada has no interest in our streams so long as they are in our respective territory. This is the attitude taken by the Province of Ontario, because they have entered into a contract in writing with the Power Company by which they are authorized to build dams, cross streams, not only boundary streams, but cross these other rivers which are referred to by these gentlemen, the Manitou River and the Seine River, to be controlled by the joint action of the Canadian government and the Company. To be sure these waters eventually sometime or other pass along the boundary stream, but this contract takes no account of any rights which anybody might claim to have on the American side; it handles that water for the interest of a certain enterprise and in the interest of a certain government, which they have a perfect right to do, and which they have assumed to do and no one on the American side was heard to say nay; but when we on the other side want to use a stream for the benefit and to promote the comfort and welfare of our country, we want them to do the same as we do, recognize our rights, as we recognize theirs.

I was very much impressed with what was said this morning regarding navigation upon the Great Lakes. With friendly co-operation of Mr. Coste and his associates, we can send them about a quarter of what Mr. Randolph is taking out, where it will be of some service. I referred to this before. We could send down a thousand cubic feet this way, if we were enabled to move the thing along through the various agencies; and I submit to you whether, in view of what was said by the various speakers this morning, that isn't the most beneficial and advantageous use of these waters for the United States and for Canada and all parties concerned, because we have provided a way for taking care of all the interests on Rainy River between Fort Frances and the Long Sault by dams above which are to be controlled in the interests of navigation and are not a diversion of water, so that we can take up these flood waters and bring them over here and help these gentlemen and their lower Ontario interests out. That is all I wish to say. I wanted to be understood as making this application plain for the benefit of these gentlemen so that they won't go away with a misapprehension as to what was being asked and what was being offered.

STATEMENT OF W. M. TILDERQUIST, ON BEHALF OF THE MINNESOTA CANAL POWER COMPANY.

DULUTH, MINN., JUNE 23, 1906.

TO THE INTERNATIONAL WATERWAYS COMMISSION,
BUFFALO, N.Y.

GENTLEMEN,—In the months of June and July, 1904, in connection with E. B. Bands, engineer for The Minnesota Canal and Power Company, I made a survey of Rainy River.

I embarked upon the river at Fort Frances, Ontario, and proceeded down the stream until I arrived at Long Sault Rapids. From that point to the Lake of the Woods, a distance of 35 to 40 miles, I examined the stream for the purpose of taking measurements of the flowage of water and ascertaining the width and depth of the river and making general observations as to the improvements upon either side and the towns and settlements thereon.

The work from Fort Frances to Long Sault Rapids was performed by Mr. Banks. I have read his statement addressed to you dated June 22, 1906, and his description of the river and the country on either side from Fort Frances to Long Sault Rapids, as contained in that statement, is correct and in accordance with my own observations. The nature of the country below the Long Sault Rapids down to near the Lake of the Woods is substantially of the same character as he describes for that part of the river below Long Sault Rapids. The American side is uncleared and uncultivated and has almost no settlers except a few that were just going in in the vicinity of Baudette. There were considerable settlements upon the Canadian side; the land was cleared and put into grass. There were a few houses observable from the river. At Boucherville, Ontario, there were two store buildings and one hotel building. The hotel was vacant; there were no stocks of goods in either of the stores but one of them was occupied by a family; the other was vacant. The settlement had the appearance of having been abandoned. There are no towns between Long Sault Rapids and Rainy River, a distance of about 25 miles, where there were not more than from two to five houses. Rainy River is a town of 1,000 to 1,200 inhabitants drawn there to work in the sawmill which is in operation at that point. The supply of logs for this mill floats down Rainy River.

Rainy River is substantially dead water from Long Sault Rapids to the Lake of the Woods. There is one place where there is a slight current. Its depth is determined by the height of water in the Lake of the Woods and that is determined by the Keewatin dam at the north end of the lake. At no time, not even in time of low water, is the river difficult of navigation from Long Sault to the Lake of the Woods.

Upon the north side of Rainy River, between Rainy River Village and the Lake of the Woods, there is an Indian Reservation upon which no improvements were discernable by me. There is an Indian Reservation in Ontario bordering on the river at the Long Sault and this reservation is unimproved except for what little hay the Indians cut.

The traffic upon the river during the two months when I was at work upon it was extremely limited. The Canadian Northern Railway seemed to do the principal business, both passenger and freight.

Respectfully submitted,

WM. M. TILDERQUIST,
Engineer.

STATEMENT AND BRIEF OF ST. CROIX LUMBER COMPANY AND FALL LAKE BOOM COMPANY IN OPPOSITION TO PROPOSED DIVERSION.

To the International Waterways Commission:—

In approaching the consideration of this subject we find that we are under the disadvantage of not being advised of the precise scope of the inquiry before the Commission. We shall assume, however, that the international features of the situation will be of primary importance, and, as we are advised that a certain application of the Minnesota Canal and Power Company for permission to obstruct and divert the waters in question, addressed to the Secretary of War, has been referred to this Commission, we assume that the hearing of the United States Statutes upon the waters in question and the limitations of the applicability of said statutes are also subjects proper to be called to the attention of the Commission. If we omit or incompletely cover any branch of the subject, upon which the Commission may desire information or argument, we shall be pleased, on notice, to comply with any request the Commission may see fit to make in that regard.

BRIEF DESCRIPTION OF PROPOSED OPERATIONS OF THE MINNESOTA CANAL AND POWER COMPANY.

The Birch Lake drainage basin, so-called, contains an estimated area of eleven hundred and three square miles, and all of the waters thereof are tributary to Birch Lake, except the waters of the North Kawishiwi River, which enters Fall Lake in Township 63, North of Range 11 West, without flowing through Birch Lake. The natural outlet of Birch Lake is through Birch River, located in Township 62, North of Range 11 West, and all of the waters in the Birch Lake drainage area flow North from Fall Lake through the various connecting lakes and streams to Rainy Lake on the international boundary, and thence through other connecting lakes and streams to Rainy River, and are thence discharged North through the Lake of the Woods and finally reach Hudson Bay. The plans of the Canal Company contemplate the erection of a dam across said Birch River at the Northern outlet of Birch Lake at the South line of Township 62 North, of Range 11 West. It is proposed to build this dam 20 feet in height, and thereby to raise the waters in Birch Lake 20 feet above mean low water level, thus creating a reservoir of extensive dimensions. In order to store in this proposed reservoir all the waters of the Birch Lake drainage area, the Canal Company further proposes to construct a diverting dam across the North Kawishiwi River at a point in Township 63 North, of Range 10 West, in order to cause the waters which naturally flow North through said North branch to back up and flow through the South branch of said river and into Birch Lake. In order to make use of the waters so stored in said Birch Lake reservoir, the Canal Company proposes to dig a canal about fifteen miles in length from the Westerly end of Birch Lake, commencing at a point in Township 61 North, of Range 13 West, and crossing the height of land and natural water-shed in Township 60 North, of Ranges 14 and 15 West, and Township 59 North, of Range 15 West. The waters North of said height of land or water-shed flow northerly into Birch Lake and its tributaries, and the waters South thereof in their natural state flow into the St. Louis River and its tributaries, and finally into Lake Superior. By means of said canal connecting Birch Lake with the head waters of the Embarrass River, which empties into the St. Louis River in Township 57 North, of Range 16 West, it is proposed to carry the waters to be stored in the Birch Lake reservoir through said canal, the Embarrass River, and the St. Louis River to a point Northwest of Duluth, in Township 50 North, of Range 17 West. From that point it is proposed to divert the waters by means of a canal to be constructed of about twenty-four miles in length to a point back of the City of Duluth, from whence the same will be led from an elevation of approximately six hundred feet to the vicinity of the Bay of Duluth, to be used in the generation of power.

THE INTERESTS OF THE ST. CROIX LUMBER COMPANY AND FALL LAKE BOOM COMPANY WOULD BE INJURIOUSLY AFFECTED BY THE DIVERSION OF WATERS AS PROPOSED BY SAID MINNESOTA CANAL AND POWER COMPANY.

The St. Croix Lumber Company is a corporation organized under the laws of the State of Minnesota. Said Company states that for many years past they have been engaged in the manufacture of lumber in the State of Minnesota; that they now own and operate a sawmill at the Village of Winton, in the County of

St. Louis, State of Minnesota, said mill being located in Section 24, Township 63 North, of Range 12 West, on the shore of Fall Lake, which is an enlargement of the Kawishiwi River; that in connection with said sawmill said company owns and operates a planing mill and also owns houses for the use of its employees at said Village of Winton; that said sawmill has been in operation since 1895, the same having formerly been owned and operated by the Knox Lumber Company; that said sawmill and equipments and other property were purchased from the said Knox Lumber Company by said St. Croix Lumber Company in the year 1900, and said sawmill has been operated continuously since said last mentioned time by said St. Croix Lumber Company; that during each sawing season said last named company has employed in and about its said sawmill and planing mill an average of two hundred and twenty-five men, and during the winter season employs in the operation of its planing mill and other work in connection with its plant from seventy-five to eighty men; that the number of men employed as aforesaid does not include any men employed in logging operations in connection with said sawmill business; that the value of said sawmill, planing mill and plant is not less than one hundred and fifty thousand dollars, exclusive of standing timber, logs and manufactured product owned by the company; that the men employed by said St. Croix Lumber Company in and about its said mill, and their families located at said Village of Winton, are dependent upon said employment for their livelihood, and constitute a large proportion of the inhabitants of said village; that the capacity of said sawmill when in operation will average two hundred and thirty thousand feet per day, operating day and night shifts, and the total average annual product of said mill is thirty-five million feet; that said sawmill is located upon a branch of the Duluth and Iron Range Railroad, and so much of the output of said sawmill and planing mill as is not disposed of to supply the market in the vicinity thereof, including the city of Ely, is shipped by rail over said Duluth and Iron Range Railroad to Two Harbors or Duluth, in the State of Minnesota, and thence re-shipped either by boat or rail to other points.

That said St. Croix Lumber Company has purchased and owns for the purpose of supplying raw material for the operation of its said sawmill plant large quantities of standing pine timber tributary to said mill, and for several years past has from time to time, as opportunity offered, increased its supplies of standing pine timber, and is now in the market for such timber of a suitable quality and location as can be purchased at market prices; that said company now owns and controls sufficient standing timber to run said sawmill at normal capacity for a period of more than twelve years; that said company now owns standing pine situated on the North branch of the Kawishiwi River in Townships 63 and 62 North, of Range 10 West, and Township 63 North, of Range 9 West, amounting approximately to twenty-five million feet, all of which timber is tributary to said sawmill by means of floating logs in the waters of the North branch of the Kawishiwi River; that approximately seventy-five million feet of timber other than that owned by said Lumber Company is tributary to said North branch of said Kawishiwi River; that said company also owns approximately one hundred million feet of standing pine timber tributary to Stony River, which empties into the southeasterly side of Birch Lake; that there is approximately one hundred and fifty million feet of standing timber in addition to that owned by said company which is tributary to said Stony River; that all of the timber above mentioned is situated in the Counties of St. Louis and Lake in said State of Minnesota. That the value of the standing timber owned by said company in said counties of St. Louis and Lake is not less than one million five hundred thousand dollars.

That the following named streams, to-wit, Birch River, Dunka River, Stony River, South Kawishiwi River and the Isabella River flow into Birch Lake, and from Birch Lake through Birch River to White Iron Lake, and thence

North to said Village of Winton, where the said mill property of said Lumber Company is located as hereinbefore mentioned, and all of said rivers and streams are useful and necessary for the purpose of floating logs from the territory surrounding Birch Lake, into Birch Lake, and from thence through Birch River to the mill of said company; that said Birch Lake, White Iron Lake and Birch River and their tributaries are public highways, and are all navigable waters, and said lakes, and Birch River, for the greater portion of its natural length, are navigable not only for the rafting and floating of logs and forest products, but are also navigable for steamboats and other craft. That all of the logs, lumber and forest products that have been cut and that are to be cut from the lands tributary to said streams and lakes and which are owned by said corporation and by other parties have their natural and only outlet down said streams into said lakes, and through the rivers connecting said lakes to the said Village of Winton.

That all of said streams and the outlets of said lakes hereinbefore mentioned have been improved by clearing the channels thereof, straightening the same, removing obstructions and building dams for the purposes of facilitating their navigation for the floating of logs, lumber and forest products down the same, to said village of Winton and other points by the Fall Lake Boom Company and the Gilham Boom Company, the operations of which have been taken over by the said Fall Lake Boom Company; that said Fall Lake Boom Company and said Gilham Boom Company are both corporations organized under the provisions of Title 1, of Chapter 34 of the General Statutes of Minnesota, 1894, and were so organized more than eight years ago, and each of said companies have and are entitled to exercise the power of eminent domain in furtherance of the general objects and purposes of boom companies. Said Fall Lake Boom Company ever since its organization has been exercising its powers as a public service corporation in connection with the improvement of the waters and streams hereinbefore mentioned, and in the driving and handling of logs for said St. Croix Lumber Company and for others, in connection with which said corporations the Fall Lake Boom Company and said Gilham Boom Company have expended in excess of $25,000 in the improvement of the public use and navigation of said streams and waters.

The construction of said proposed dams and other works by the applicant, and the diversion of said waters from their natural outlet will destroy or seriously impair the said Birch River and Kawishiwi River as floatable or navigable streams, and prevent or seriously hinder the floating of logs down said streams from Birch Lake and its tributaries, including said Stony River, and from White Iron Lake, and its tributaries, to the village of Winton, and thus render the cutting of logs for the manufacture of lumber or forest products at the village of Winton unprofitable, and impair the value of the property of said Lumber Company, both as to its mill property at Winton, and as to its timber standing on said lands within the watershed before referred to. That one of the reasons why said mill property and standing timber will be rendered worthless is that there are no other streams or natural highways down which said timber can be transported to said mill for manufacture, and said mill is dependent upon the timber and forest products from said watershed for its supply. There are no railroads or other means of transportation that are available to reach said timber and transport it to the mill of said corporation, or to any other point for manufacture, and to cut and transport said timber from the lands hereinbefore referred to to any other point available for its manufacture would entail an expense so great that the same could not be done except at a heavy loss.

The diversion of said waters as proposed by the Canal Company will necessarily seriously hamper the operations of said Fall Lake Boom Company, and will be likely to so far interfere with said operations as to prohibit any profitable use of the improvements made by said Boom Companies, and result in the practical destruction of said Company's properties and the confiscation of contracts which the Fall Lake Boom Company has with the said Lumber Company and others for driving and handling logs.

BIRCH LAKE, BIRCH RIVER AND THE CONNECTING WATERS TO AND ALONG THE INTERNATIONAL BOUNDARY ARE NAVIGABLE WATERS OF THE UNITED STATES, AND EXCEPT INSOFAR AS AFFECTED BY INTERNATIONAL RIGHTS, ARE UNDER THE CONTROL OF CONGRESS.

These waters are navigable in fact. As above shown a portion of the same are extensively used at the present time by the St. Croix Lumber Company, Fall Lake Boom Company and others in the transportation of sawlogs.

At the hearing before the District Court of St. Louis County, Minnesota, Eleventh Judicial District, in the case of Minnesota Canal and Power Company, Petitioner, vs William C. Yawkey, *et al*, Respondents, on application of the petitioner for the appointment of commissioners in condemnation proceedings, Mr. L. W. Ayer testified that he had personally examined the watercourse between said Birch Lake in St. Louis County, Minnesota, and Koochichin Falls on Rainy River on the international boundary. Affiant gave it as his opinion that under existing conditions by use of the present improvements sawlogs could be floated in times of high water from Birch Lake to Koochiching Falls. As we understand, there is at present no necessity for floating sawlogs over these waters, as there are no mills established on the same below Fall Lake, so far as we are advised. During the open season of navigation there is operated on Birch Lake a boat propelled by steam power which is used in connection with the rafting and transportation of logs. There are also employed on the waters of Eve Lake and Fall Lake similar boats. There are six Canadian and two American steamboats operating on Rainy Lake along the international boundary, two of which boats make regular trips between International Falls and Kettle Falls, the distance between said points being about thirty-five miles. There is also operated on Namekan Lake, a part of the connecting waters between Birch Lake and International Falls, a steamboat known as the "Rutheford Hayes," which carries American mail. The country between Fall Lake and International Falls is at present practically unsettled, and substantially all of the business which has been carried on in that region consists of lumbering on a limited scale, and said waters will naturally be used to a far greater extent and for a greater variety of purposes when the adjacent country becomes well settled. From investigations made we feel warranted in asserting that the volume of water which is discharged through the waterway connecting Birch Lake and the international boundary is sufficient to permit of the passage of steamboats and other watercraft throughout the length of said waterway, provided the various rapids occurring therein are suitably improved by canals and locks.

In view of the situation and use of these waters it is clear that they are navigable waters of the United States as defined by its Supreme Court. The definition of navigable waters and navigable waters of the United States contained in the case of the Daniel Ball, 10 Wall. 557, 1870, is very generally followed and quoted in subsequent cases, both in United States courts and in state courts. The question before the court was the extent of the admiralty jurisdiction of the United States, and depended upon whether Grand River, a stream wholly within the State of Michigan, but connecting with Lake Michigan should be considered navigable water of the United States. The court said:

"Those rivers must be regarded as public navigable rivers in law which are navigable in fact. And they are navigable in fact when they are used or are susceptible of being used, in their ordinary condition, as highways for commerce, over which trade and travel are or may be conducted in the customary modes or trade and travel by water. And they constitute navigable waters of the United States within the meaning of the Acts of Congress, in contradistinction from the navigable waters of the states, when they form in their ordinary condition by themselves, or by uniting with other waters, a continued highway over which commerce is or may be carried on with other states or foreign countries in the customary modes in which such commerce is conducted by water."

The court found that Grand River, which is navigable by boat for a distance of forty miles from its mouth, forming by its junction with the lake a continuous highway for commerce, both with other states and with foreign countries is a navigable river of the United States. The opinion in the above case was written by Judge Field.

THE MONTELLO, 20 WALL. 430.

This is one of the leading cases defining navigable waters of the United States.'' The status of the Fox River in Wisconsin was under consideration The Court said :

''The rule laid down by the district judge as a test of navigability cannot be adopted, for it would exclude many of the great rivers of the country which are so interrupted by rapids as to require artificial means to enable them to be navigated without break. Indeed, there are few of our freshwater rivers which did not originally present serious obstruction to an uninterrupted navigation. In some cases, like the Fox River, they may be so great while they last as to prevent the use of the best instrumentalities for carrying on commerce, but the vital and essential point is whether the natural navigation of the river is such that it affords a channel for useful commerce. If this be so the river is navigable in fact, although its navigation may be encompassed with difficulties of natural barriers, such as rapids and sand-bars."

In the case of Escanaba Co. *vs.* Chicago, 107 U.S. 678-682, the court said :

''The power vested in the general government to regulate interstate and foreign commerce involves the control of the waters of the United States which are navigable in fact so far as it may be necessary to insure their free navigation, when by themselves, or in connection with other waters, they form a continuous channel for commerce among the states or with foreign countries." In that case the Chicago river, a stream wholly within the State of Illinois, was held to be navigable water of the United States. The court held that the ordinance of 1787 does not effect the question of congressional or state control. The states formed out of Northwest Territory were admitted upon an equal footing with the original states. This case was decided prior to the Acts of 1890 and 1899.

See United States *vs.* Burlington, &c., Co., 21 Fed. 331.

U.S. *vs.* Rio Grande, &c., Co., 174 U.S. 690.

For collection of cases as to what are and what are not navigable waters, either of the United States or the States, see 7 Notes on U.S. Reports, page 365, in treatment of the case of The Daniel Ball.

81 Am. Dec. page 582, in the case of Davis *vs.* Winslow.

16 Am. and Eng. Ency. of Law, 1st Ed. 236.

A river capable of floating to market the products of the forest or farm, and upon which boats, barges, rafts or logs may be borne, is a navigable stream both in fact and in law. The criterion of navigability is the use to which the stream may be put.

Rhodes *vs.* Otis, 33 Ala. 578-73 Am. Dec. 439.
Whistler *vs.* Wilkinson, 22 Wis. 572.
Wadsworth *vs.* Smith, 11 Me. 278-26 Am. Dec. 525.
Treat *vs.* Lord, 42 Me. 552-66 Am. Dec. 298.
Thunder Bay Booming Co. *vs.* Speechly, 31 Mich. 336.

It is not necessary to give the character of navigability to a stream that it shall be capable of being used for navigation continuously at all seasons of the year. It is sufficient if it may be prudently relied upon for use at some seasons of the year, occurring with tolerable regularity.

Walker *vs.* Allen, 72 Ala. 456.
Little Rock, &c., *vs.* Brooks, 39 Ark. 403.
Edrich *vs.* N.W.R. Co., 42 Wis. 203.
Morgan *vs.* King, 35 N.Y. 454.

Navigable waters include all those which afford a channel for useful commerce. Such waters are common highways.

Castner *vs.* Steamboat, 1 Minn. 73.
Schumeier *vs.* St. Paul, &c., Co., 10 Minn. 82.
Same case, 7 Wall. (U.S.) 272.
Swanson *vs.* Miss. etc. Boom Co., 42 Minn. 532.
St. P. R. Co. *vs.* First Div., &c., 26 Minn. 31.

Moreover, the waters in question have been decided by the Secretary of War to be navigable waters of the United States under the control of Congress, and subject to the provisions of Sections 9 and 10 of the Act of March 3, 1899 (30 Stats. 1151). Investigation and decision of that question came about in this way: Quite a large portion of the lands proposed to be crossed and flooded by the Minnesota Canal and Power Company are public lands belonging to the United States. The Canal Company made application to the Secretary of the Interior in the year 1904 for permission for right of way over the lands in question under the provisions of the Act of Congress approved February 15, 1901 (31 Stats. 709). In the course of his investigation of the subject of the application, the Secretary of the Interior called upon the Secretary of War for a report as to the status of the waters involved. In a letter dated May, 13, 1904, the Secretary of War advises the Secretary of the Interior as follows :—

"Rainy River (or Rainy Lake River, so-called), is the outflowing stream from Rainy Lake and its waters flow into the Lake of the Woods. The river forms a part of the International boundary between the United States and the Dominion of Canada and is understood to be navigable water, as defined by the Supreme Court of the United States. xxx. As the river is a navigable waterway in which both the United States and the Dominion of Canada are interested, any project that would be likely to interfere with the navigable capacity of the stream should have the sanction not only of the Government but of the Government of the Dominion of Canada.

"The project of the Minnesota Canal and Power Company contemplates the utilization of the waters of the St. Louis River, which is also a navigable water of the United States, and is understood to be navigable in both the States of Wisconsin and Minnesota. xx. The construction of a dam or dams across the St. Louis River comes within the purview of section 9, of the River and Harbor Act of March 3, 1899, and would be unlawful unless specially authorized by Congress."

Thereafter and by letter dated October 27, 1904, the Commissioner of the General Land Office denied the said application of the Canal Company, a copy of which letter, marked Exhibit "A," is hereto attached. On application of the Canal Company the subject was re-opened to permit of further investigation as to the character of the waters. The question was again referred to the War Department, and a report was called from Major G. McC. Derby and Major

C. L. Potter, Corps of Engineers, U.S. Army, the officers in charge of the territory in which the waters are located. A public hearing was had before said Engineers at which said Canal Company was represented and submitted documents and oral argument. Major Derby reported that in his judgment the waters of Birch Lake and connecting waters to the North to the international boundary are navigable waters of the United States within the purview of said Acts of Congress, and his findings and report in that regard were concurred in by the Chief of Engineers of the U.S. Army and by the Secretary of War. The report of Major Potter was confined to the waters of the St. Louis River. The letter of the acting Secretary of War, addressed to the Secretary of the Interior, covering the above subject, is dated June 15, 1905, and a copy thereof, marked Exhibit ''B,'' is hereto attached.

EFFECT OF THE PROPOSED DIVERSION OF SAID WATERS UPON THE NAVIGABILITY OF THE STREAMS AND LAKES AFFECTED.

As heretofore pointed out, the business and operations of the said St. Croix Lumber Company and Fall Lake Boom Company would be disastrously affected by the erection of the dams and diversion of the waters proposed by the said Canal Company, and the navigable capacity of the portion of said waters utilized by said companies and others for purposes of navigation would be seriously impaired, if not actually destroyed.

The navigable capacity of said waters below Fall Lake and along the international boundary would also be seriously affected. This is made to appear by affidavits of James J. Darcy, Richard F. Fagan and Martin Dillon, hereto attached, marked respectively Exhibits "C," "D," and "E," and copy of affidavit of William Shoop, also hereto attached, and marked Exhibit "F," all of which are hereby referred to.

Moreover, it appeared by the admission of said Minnesota Canal and Power Company in its petition filed in condemnation proceedings in the District Court of Itaca County, Minnesota, that the said Birch Lake drainage area, affected by the operations of said company, constitutes about one-sixth of the total drainage area tributary to Rainy River, and we are informed that as a matter of fact the proportion is much greater.

UNITED STATES STATUTES APPLICABLE.

Sections 9 and 10 of the Act of Congress of March 3, 1899, (30 Stats. 1151) govern the waters in question, except insofar as the same may be subject to international control and treaty obligations. By virtue of these statutes Congress has asserted the national jurisdiction over these waters and the navigable capacity of the same cannot in any manner be impaired, or any obstruction therein created without the consent of Congress, and the approval of the Secretary of War and Chief of Engineers.

U.S. vs. Rio Grande, &c. Co., 174 U.S. 690.
Escanaba Co. *vs.* Chicago, 107 U.S. 678.
Willamette, &c. Co. *vs.* Hatch, 125 U.S. 1.
Cummins *vs.* Chicago, 188 U.S. 410.

CONSENT OF STATE AS WELL AS OF UNITED STATES NECESSARY.

The Supreme Court of the United States held in the case of Cummins *vs.* Chicago, 188,U.S. 410, decided in 1903, that where navigable waters of the United States lie wholly within the limits of a state, the jurisdiction of the state with respect to the prohibition of the erection of the obstructions in such waters was not suspended by virtue of the said Acts of Congress above cited, but, in the words of the court:—

"The effect of that Act, reasonably interpreted, is to make the erection of a structure in a navigable river, within the limits of a State, depend upon the concurrent or joint assent of both the National Government and the State Government. The Secretary of War, acting under the authority conferred by Congress, may assent to the erection by private parties of such a structure. Without such assent the structure cannot be erected by them. But under existing legislation they must, before proceeding under such authority, obtain also the assent of the State acting by its constituted agencies."

See also Montgomery *vs.* Portland, 190 U.S. 89.

This is a most important consideration with respect to the subject now before the commission. The waters of Birch Lake and the streams flowing North therefrom, until the same reach the international boundary, are wholly within the State of Minnesota, and therefore fall within the class of waters treated in the case of Cummins *vs.* Chicago. The State of Minnesota has not by any express legislation authorized the obstruction and diversion of said waters, as proposed by the Minnesota Canal and Power Company, but, on the contrary, has expressly prohibited the same.

Legislative prohibition is found in Section 2385, Gen. Stats. 1894, the same being Act of July 28, 1858, and Section 1, of Chap. 32, Revised Statutes of 1866, reads as follows:

"All rivers within this state of sufficient size for floating or driving logs, timber or lumber, and which may be used for that purpose, are hereby declared to be public highways, so far as to prevent obstruction to the free passage of logs, timber or lumber down said streams, or either of them."

Section 2 of Article 27, Constitution of the State of Minnesota, reads as follows:—

"The state of Minnesota shall have concurrent jurisdiction on the Mississippi and on all other rivers and waters bordering on the said State of Minnesota, so far as the same shall form a common boundary to said state and any other state or states now or hereafter to be formed by the same; and said rivers and waters, and navigable waters leading into the same, shall be common highways, and forever free, as well to the inhabitants of said state as to other citizens of the United States, without any tax, duty, impost or toll therefor."

The Supreme Court of the State of Minnesota in the case of the Minnesota Canal and Power Company *vs.* Koochiching Company (not yet officially reported), upon a very exhaustive consideration of this very proposition to obstruct and divert the waters in question by the Minnesota Canal and Power Company, decided that under the laws of said state such obstruction and diversion would not be permitted. We call attention to the following portion of the opinion of the Supreme Court of the State of Minnesota in the above mentioned case, announcing its conclusions with respect to this matter.

"It is true that the trial court has found that the carrying out of the appellant's enterprise would not substantially interfere with the capacity of the lakes for navigation or any other public use to which they have at any time been put. This finding deals entirely with conditions as they have existed in the past and it is not determined that the enterprise will not interfere with the more extensive use of the waters which is inevitable in the future as the country develops and navigation increases. The court does find that it would at times prevent the floating of logs over the rapids in the rivers connecting the lakes within the state, unless the petitioner's dams would be so operated as to furnish water for the driving of the logs down the stream at such times as there should be logs to drive, and 'it would not be impossible to so operate said dams.' This means that the navigation of the streams would be placed under the control of the appellant to be regulated as it should see fit, thus giving to it as an incident to the power to create a canal and water power at Duluth the overlordship and control of navigation on large and important public waters of the state. There is at least one stream in this state over which such control has been delegated to a private corporation, but the intention of the legislature to convey similar powers over other streams should be made to appear by the unambiguous language of a positive statute.

We find no such grant, and in view of the presumption in favor of the rights of the individual, the state and federal prohibition against the obstruction of navigable waters, the rule that the rights of the state in such waters are sovereign and not proprietary, that they are held in trust for the public as highways and cannot be alienated, (citing cases), the possible effect upon the rights of riparian proprietors in the Province of Ontario, the fact that the doctrine of the appropriation of waters adopted in some of the Western states does not prevail in Minnesota and is not recognized by the conventional law of nations (Pine *vs.* May or, 112 Fed. 98, s.c. 185 U.S. 93; Holyoke &c. Co. vs. Conn. River Co., 20 Fed. 71), the treaty relations between the United States and Great Britain with reference to the boundary waters between the United States and Canada (7 Fed. Stats. Ann. pg. 583,) and that the taking of the waters will interfere with streams and lakes which are already devoted to public uses, which can only be done under express statutory authority (Minneapolis and St. L. Ry. Co. *vs.* Village of Hartland, 85 Minn. 76), we are constrained to hold that the appellant is not authorized to condemn the interests sought to be condemned in the lands of the respondents for the purpose of constructing the canal and creating water power in the manner described in the petition. The petitioner's enterprise necessitates the doing of what is not only not expressly or by fair inference authorized, but is expressly forbidden by the Statutes of the State of Minnesota, and of the United States, without the consent of its representatives."

It should be stated, however, that since the said decision of the Supreme Court of the State of Minnesota, the Canal Company has amended its articles of incorporation, and has started a new proceeding in condemnation in the District Court of St. Louis County, in said state, wherein it is seeking to avoid the effect of said decision, and is also relying upon certain changes made in the laws of said state by reason of the taking effect on the first day of March, 1906, of what is known as Revised Laws 1905. In view, therefore, of these late proceedings on the part of the Canal Company, the subject matter before this Commission cannot be regarded as a closed incident, so far as the Courts of the State of Minnesota are concerned, though we claim that the aforesaid decision of the State Supreme Court will really control the ultimate decision of the new proceedings instituted by the Canal Company. This, however, is a matter for subsequent adjudication.

Not only has the state not given its consent to the obstruction and diversion of said waters, but it has been judicially determined that the state would have no authority to give its consent thereto, because the waters are held in trust by the state for public use as navigable waters, and such trust is incapable of alienation.

This proposition is fully established by decisions of the Supreme Court of Minnesota.

Lamphrey *vs.* State, 52 Minn. 181.

In this case Mitchell, J., delivering the opinion of the Court says (p. 198):

"Where the lake is navigable in fact, its waters and bed belong to the state in its sovereign capacity, and the riparian patentee takes the right only to the water's edge."

Willow River Club *vs.* Wade, 100 Wis. 86.

Bradshaw *vs.* Duluth Imperial Mill Co., 52 Minn. 59.

In this case Mitchell, J., delivering the opinion, says (p. 65):

"It is a settled law with us that the rights of the state in navigable waters and their beds are sovereign, and not proprietary, and are held in trust for the public as a highway and are incapable of alienation."

Union Depot, &c., *vs.* Brunswick, 31 Minn. 297.
Hannaford, *vs.* St. and D. R. Co., 43 Minn. 104.
Rossmiller *vs.* State, 114 Wis. 169.

In the last mentioned case the court said:

' This court has repeatedly said that the navigable waters of the state have substantially the incidents of tidal waters at common law; that the title to the beds of such waters was reserved for the state by the Ordinance of 1787, and vested in it the instant it was admitted into the Union, to preserve the public character of such waters, with all such incidents, and that the state never has and never can constitutionally impair the trust."

McLennon *vs.* Prentice, 85 Wis. 427, 444.
Village of Pewaukee, *vs.* Savoy, 103 Wis. 271.

The court in that case uses the following language, citing the following cases:

"It is the settled law that submerged lands of lakes within the boundaries of the state, belong to the state in trust for public use, substantially the same as submerged lands under navigable waters at common law. Upon the admission of the state, into the Union, the title to such lands by operation of law vested in it in trust to preserve to the people of the state forever the common rights of fishing, and navigation, and such other rights as are incident to public waters at common law, which trusteeship is inviolable, the State being powerless to change the situation by in any way abdicating its trust."

Priewe *vs.* Wis. State Land and Imp. Co., 93 Wis. 534.
Willow River Club *vs.* Wade, 100 Wis. 86.
Shively *vs.* Bowby, 152 U.S. 1.
Illinois Central Railroad *vs.* Illinois, 146 U.S. 387-452.

THE WATERS IN QUESTION ARE INTERNATIONAL AND ARE PROTECTED BY TREATY.

Said international waters are protected by Article 2 of treaty between the United States and Great Britain under date of August 9, 1842, proclaimed November 10, 1842, and known as the Webster-Ashburton Treaty. This treaty is found in 7 Federal Statutes Annotated p. 582.

The last clause of said Article 2 reads as follows: "It being understood that all water communications and all the usual portages along the line from Lake Superior to the Lake of the Woods, and also Grand Portage from the shore of Lake Superior to the Pigeon River, as now actually used, shall be free and open to the use of the citizens and subjects of both countries."

Section 3 of Article 3 of U.S. Constitution provides that: "This Constitution and the laws of the United States which shall be made in pursuance thereof and all treaties made or which shall be made under the authority of the United States shall be the supreme law of the land, and the judges in every state shall be bound thereby, anything in the constitution or laws of any state to the contrary notwithstanding."

As hereinbefore shown, it is conceded that the Birch Lake drainage basin contributes about one-sixth of the boundary waters of Rainy River and its connections. If the present proposed diversion is correct in principle, then other diversions may take place which would still more seriously impair the capacity and use of the boundary waters contrary to the provisions of said treaty.

Irrespective of express treaty obligations, the United States ought not, as a matter of international comity, to authorize any such interference with waters within its own territory as will impair the use and navigability of waters of a neighboring nation.

The following quotation is from the late work of Farnham, 'Waters and Water Rights, Vol. 1, p. 29,' and contains, it seems to us, a fair statement of the law governing international and interstate rivers.

"6. International and interstate rivers.—A river which flows through the territory of several states or nations is their common property. Each is entitled to its navigation throughout its whole extent, so far as it can be exercised without injury to the rights of others. It is a great natural highway conferring, besides the facilities of navigation, certain incidental advantages, such as fishery and the right to use the water for power and irrigation. Neither nation can do any act which will deprive the other of the benefits of those rights and advantages. The inherent right of a nation to protect itself and its territory would justify the one lower down the stream in preventing by force the one further up from turning the river out of its source, or in consuming so much of the water for purposes of its own as to deprive the former of its benefit. Conversely, the upper owner would have a right to prevent an obstruction of the stream which would prevent fish from ascending to its shores, or interfere with its rights of navigation. ***The gifts of nature are for the benefit of mankind, and no aggregation of men can assert and exercise such rights and ownership of them as will deprive others having equal rights, and means of enjoying them, of such enjoyment. The acts of nations must be governed by principles of right and justice. The days of force and self aggrandizement at the expense of neighboring nations are past, and the common right to enjoy the bountiful provisions of Providence must be preserved."

See Kansas *vs.* Colorado, 185 U.S. 125.
Missouri *vs.* Illinois, 180 U.S. 208.
Pine *vs.* New York, 112 Fed. 98.
Holyoke Water Power Co. *vs.* Conn. River Co., 20 Fed. 71.

In behalf, therefore, of the said interests which we represent, and in consideration also of the public rights and international obligations involved, we respectfully submit that permission to obstruct and divert said waters as proposed should be withheld.

H. J. Grannis and J. N. Seaules,

Attorneys for St. Croix Lumber
aud Fall Lake Boom Company.

EXHIBIT A.

'F' 58175-69201-89789-132883-1904.

DEPARTMENT OF THE INTERIOR,
General Land Office.
WASHINGTON, D.C., October 27, 1904.

Register and Receiver,
Duluth, Minnesota.

Sirs,—With letter of February 26, 1904, and April 14, 1904, there were transmitted from your office copy of the Articles of Incorporation and other papers relating to the organization of the Minnesota Canal and Power Company, together with maps and field notes of survey, in duplicate, of certain reservoirs and canals located by said company—all comprising the company's application for the right of way for the reservoirs and canals, under the Act of March 3, 1891 (26 Stat. 1095) and that of May 11, 1898 (30 Stat. 404.)

The maps and field notes show a system of dams, reservoirs and canals, by means of which the water from the Rainy River water-shed, comprised of Birch, Gabro, Bald Eagle, Isabelle and other lakes, and Birch, North and South Kawishiwi, Stony, Isabelle and other rivers, is to be diverted and turned into the Embarrass river; thence into the St. Louis river, and thence into a small canal carrying it to an immense power station at or near the city of Duluth, Minnesota. As stated in the articles of incorporation and in the application, the purpose of this system,

'is the creation of a water power plant at Duluth, Minnesota, and elsewhere in the State of Minnesota, to supply power to municipalities, corporations, individuals and the public at large direct from its water wheels, and also to generate and distribute electricity for light, heat and power, and to supply water for the use of any municipality desiring the same and the inhabitants thereof, and to provide irrigation when needed to lands adjacent to its general work of improvement, and to run and drive logs and timber.'

During the pendency of this application before this office, the company's attorney apparently recognized the fact that the acts of March 3, 1891, and May 11, 1898, supra, were not applicable in the premises, for, in a written communication it is stated that the company desired to have its application considered as having been made under the provisions of the act of February 15, 1901(31 Stat. 790).

As the application appeared to conflict with the rights of 'The Koochiching Company,' which had been authorized by Congress to construct a dam across Rainy River, and as it embraced certain waters which appeared to be under the supervisory authority of the Secretary of War, the matter was submitted to the Secretary of War for consideration and a report. There follows the reply of the Secretary of War:—

' I have the honor to acknowledge the receipt of your letter of the 3rd instant, enclosing copy of a communication from the commissioner of the General Land Office, with tracing on which is delineated certain reservoirs and canals proposed to be constructed by the Minnesota Canal and Power Company, and for which the Company has applied for a right of way under the provisions of an act of Congress approved February 15, 1901, also asking to be informed regarding the rights of a company known as the Koochiching Company, which has been authorized to construct a dam across Rainy River, and whether the waters proposed to be utilized by the Minnesota Canal and Power Company come within the supervisory authority of the Secretary of War.'

Replying thereto, I beg to inform you that the Chief of Engineers, U.S. Army, to whom the matter was referred, reports under date of 9th instant, as follows:—

'By acts approved May 4, 1898, May 4, 1900, and June 28, 1902, Congress authorized the Koochiching Company to construct a dam, canal and works necessarily incident thereto, for water-power purposes, across the Rainy Lake River, at any part of the rapids in Sec. 27, T. 71 N., R. 24 W., of the 4th principal meridian, in the State of Minnesota. In pursuance of this authority the Secretary of War, under date of December 15, 1900, approved the plan and location of the proposed dam, subject to the following conditions:

'That the dam shall be so constructed that a suitable lock for navigation purposes may be built in connection therewith on the American side of the river.

That suitable booms for guiding logs through the log sluice shall be provided and the fishway shall be constructed in a manner satisfactory to the engineer officer in charge of the district.'

'Rainy River (or Rainy Lake River, so called), is the outflowing stream from Rainy Lake and its waters flow into the Lake of the Woods. The river forms a part of the international boundary between the United States and the Dominion of Canada, and is understood to be a navigable water, as defined by the Supreme Court of the United States. There are submitted herewith copies of letters from representatives of the Koochiching Company, describing the conditions on the river, and setting forth the project of that company. I am unable to say whether the project of the Minnesota Canal and Power Company would interfere with the rights of the Koochiching Company, as alleged; but, in my opinion, as the river is a navigable waterway in which both the United States and the Dominion of Canada are intersected, any project that would be likely to interfere with the navigable capacity of the stream should have the sanction not only of this Government, but also of the Government of Canada.

'The project of the Minnesota Canal and Power Company, as indicated by the tracing, contemplates the utilization of the waters of the St. Louis river, which is also a navigable water of the United States, and is understood to be navigable in both the states of Wisconsin and Minnesota. The portion of the river within the limit of the proposed operations of the company has a good navigable depth. From the Duluth Ship Canal for a distance of ten miles, the depth in the river is 20 feet, thence up to New Duluth the depth is twelve feet and from New Duluth to Fond du Lac the available depth is about seven feet. The construction of a dam or dams across the St. Louis river comes within the purview of section 9 of the River and Harbor Act of March 3, 1899, and would be unlawful unless specially authorized by Congress. The diversion of water, or any projects which involve the modification of the course, location, condition or capacity of the river, comes within the purview of section 10 of the said act, and would be unlawful unless authorized by the Chief of Engineers and the Secretary of War.'

The copies of letters referred to by the chief of Engineers are transmitted herewith, and the tracing which accompanies your letter is returned as requested.'

Many of the public lands affected by the right of way were withdrawn for the proposed Lake Superior Forest Reserve prior to the filing of the company's said application, so that a special agent of this office was directed,

'to examine the proposed right of way and report what work has been performed in connection with the enterprise, the necessity for the right of way, and whether the proposed enterprise will interfere in any manner with the proper occupation of the Reserve by the Government or with the enforcement of the rules and regulations for the care and management thereof; also, to submit such other information as may be obtainable and will assist this office in arriving at a proper conclusion in the consideration of the matter, and state whether there are any reasons why the application should not be submitted to the Secretary of the Interior for approval.'

This officer made a most thorough investigation and has submitted a comprehensive report. In brief, he finds,

First, that the effect of the diversion of the water from the Rainy River water-shed will work hardship and often disaster to many industries already established and dependent upon the flow of said waters in a northerly direction.

Second, that two natural water-powers located on Birch river, each of which is capable of developing an immense amount of power will be completely destroyed by a diversion of the water from its present course.

Third, that the proposed diversion of water would deprive many settlers and inhabitants of the section of country drained by the waters of Birch Lake of their present means of egress and ingress and render this territory useless so far as settlement is concerned.

Fourth, that the proposed diversion of water would doubtless give rise to international complications by reason of the fact that the Rainy river is an international waterway; also that it would work considerable damage to the United States Government in its work of developing a harbour at War Road, Minnesota.

Fifth, that many, if not all, of the lakes and streams which the company proposes utilizing, are navigable.

As to the effect on the proposed Lake Superior Forest Reserve, he reports,

'recently, I made a trip by canoe over the waters extending over the proposed Lake Superior Forest Reserve and included in the application for a right of way by the Minnesota Canal and Power Company, and carefully inspected the same. As a rule, the banks of these lakes and rivers are high and picturesque and add much to the natural scenery of the river. In some cases, the erection of reservoirs as proposed by this company would cause small tracts of land lying adjacent to the lakes and rivers and within the reserve, to become inundated and thus destroy the appearance of the shores and kill all vegetation growing between the present natural water line and that created by the formation of the reservoirs. It would also mean that waters in these reservoirs and within the reserve would be lowered and raised at the will of the corporation, and have no fixed position as at present, and that the corporation would have to maintain a force of employees within the reserve to control the dams and the water within the reservoirs, and, in a measure, have jurisdiction over the government of at least a portion of the reserve. In my judgment, the Government would experience considerable trouble in its proper government of the reserve were it to permit this or any other corporation a foothold within the same.

'At present, the reserve can be reached by a natural water course from Winton, Minnesota, by canal or pleasure crafts, while, if the right of way were granted and the water diversion, it could only be reached by way of the Embarrass Canal, which, in my opinion is impracticable. For this reason, if no other were given, the application should be denied.

'The proposed reserve is one of the most picturesque spots in the United States and, in time, will rival the Yellowstone Park. It is rough, wild and broken country, connected at all points by a network of lakes and rivers, many of which are not given on the official plans, and composed of a very small amount of merchantable timber. The reserve already abounds in game, among the larger of which are to be found moose, deer, bear, caribou and panther, and with proper protection can be made the greatest game preserve within the United States. On my trip through these waters, dozens of moose and deer were visible along the shores. To allow a change to be made in the natural condition of these lakes and waters would be to drive the game outside of the reserve into Canadian territory. It is a well known fact that where lakes and other bodies of water are made to change their natural appearance, the game will abandon said streams and congregate elsewhere.

'Further, this company has done no actual work looking to the completion of its power scheme, except to make its preliminary survey, which, in fact, is a mere imitation of the former survey made by the Highland Power and Canal Company, and to begin some condemnation proceedings. They have, as yet, not turned one foot of earth or caused one day's labour on any of their proposed dams. They appear to be still trying to get a hold on some territory within the reserve and elsewhere so as to shut out some rival company should one appear, and to use this as a leverage in its State condemnation proceedings.

'I believe the department should go slow in granting this concern rights within the reserve, as there would be no end to the trouble, if an attempt were made later on to terminate those rights.'

In view of the above reports, this office must reject the said application, subject to appeal to the Secretary of Interior within sixty days.

Notify the company hereof, and in due time, report in the premises.

There have been filed several protests against the allowance of the said application, which, in view of its rejection, do not require consideration by this office. The protestants, however, should be notified of the rejection of the application. Accordingly, you are directed to notify the Enterprise Iron and Land Company, Frederick B. and Marian A. Spellman, whose protests were filed in your office and this office will notify the others.

Very respectfully,
(Signed) W. A. RICHARDS,
Commissioner.

EXHIBIT B.

WAR DEPARTMENT, WASHINGTON, D.C., June 15, 1905.

Sir,—Referring to your letter of Dec. 14, 1904, transmitting correspondence regarding the application of the Minnesota Canal and Power Company for the use of certain public lands of the United States in connection with the company's project for the construction of reservoirs and canals for the utilization of the waters of the Rainy River, St. Louis River and other tributary streams in the State of Minnesota and replying to your request for opinion whether on the showing now presented by the company the application should be allowed in view of its possible interference with the navigable capacity of the streams affected and the work now being done by the Government in developing the harbour at War Road, Minnesota; also whether the project comes within the purview of section 10 of the River and Harbour Act, March 3, 1899, and whether the construction of the contemplated dams and streams in the Rainy River Drainage require the authorization or approval of the Secretary of War provided by Section 9, of same Act; I have the honour to invite your attention to the enclosed report, dated the 7th inst, by Chief of Engineers, concerning the question presented and to enclose copies of reports of Maj. G. McDerby and Maj. C. L. Potter, Corps of Engineers, the District engineer officers.

From paragraph 4, of the letter of the Chief of Engineers, it will be noted that the following conclusions are reached.

a. That Birch Lake and its connecting streams to the International boundary line, and the St. Louis River, are navigable waters of the United States.

b. That the construction of dams across, and the diversion of water from, any of these streams comes within the purview of the laws enacted by Congress for the preservation and protection of navigable water.

Report 2.

c. That Birch Lake and connecting streams, being wholly within the limits of the State of Minnesota, dams may be built thereon under the authority of the laws of the state, provided the plans of the structures are submitted to and approved by the Chief of Engineers and the Secretary of War, as required by section 9 of the act, and that the waters of these streams may be diverted if the work is recommended by the Chief of Engineers and authorized by the Secretary of War, as provided by section 10 of said act.

d. That the contemplated diversion of the waters of the St. Louis river, without the construction of a dam may also be authorized by the aforesaid section 10 of the Act of March 9, 1899.

Attention is also invited to the other features pertaining to the application of the company discussed by the Chief of Engineers in his report.

The papers submitted with your letter of Dec. 4 last are herewith returned.

(Signed) ROBERT SHAW OLIVER,

Acting Secretary of War.

The Hon. Secretary of the Interior,
Washington, D.C.

Enclosures 7 to 12 of 6753, 2 enclosures, unmarked.

EXHIBIT 'C.'

State of Minnesota, }
} ss
County of St. Louis. }

James J. Darcy being first duly sworn on oath deposes and says: That he is a resident of said St. Louis County and more than 21 years of age; that he is a cruiser, explorer and timber estimator; that for the past seven or eight years he has been continuously employed in such business and during a large part of such time has been occupied in cruising and exploring along the Canadian frontier in the neighbourhood of Basswood Lake; that he is perfectly familiar with the waters of said Basswood Lake and its tributaries and knows from actual experience on the ground, the sources of such water supply, the character of the waters, their navigability, &c.;

That Basswood Lake is a navigable body of water extending along the Canadian border for a distance of over fifteen miles and having several long indentations to the south; that all of these inlets are also navigable and the whole body of water has been used and is now being used for towing logs to a point located in Section 20-64-10 where they are transformed to a logging railroad and transported a distance of four miles to mills located on Fall Lake; that a tug drawing six feet of water is now used for such purposes of towing logs and also for carrying freight over said Lake; that Basswood Lake empties into Crooked River and thence into Crooked Lake.

That Basswood Lake derives its water supply from the following sources: From the streams flowing south-westerly from the portage in Section 24, Township 66 North of Range 6 West of the Fourth Principal Meridian through Knife Lake and Carp Lake and thence into the small stream located in Sections 1 and 2, Township 64 North of Range 9 West (Prairie Portage) where the waters are joined by certain waters flowing north-easterly through Moose Lake and Newfound Lake; that all of these waters are not large in quantity and do not drain any large tract of land for the reason that the streams upon Hunters Island flow northward and for the further reason that the streams northwesterly from the divide in Section 24, Township 66, North of Range 6 West flow to the north of Hunters Island; that Wind Lake and Urn Lake connect with southerly arms of Basswood Lake by small creeks or rivulets but do not add materially to the volume of water in Basswood Lake; that the same is true of the small area drained by a creek that empties into the westerly arm of Basswood Lake at a point near the dividing line between Sections 8 and 17 in Township 64 Range 11; that with the exception of these insignificant supplies last mentioned and the more considerable supply flowing from the north-east through Knife Lake as above mentioned, Basswood Lake gets all its water supply through Fall lake; that in the opinion of the affiant ⅝ of the waters of Basswood Lake empty into the Lake through Fall Lake; that in the opinion of the affiant very great damage would result to the navigable capacity of Basswood lake by the diversion of the streams flowing into the same through Fall lake and that the final result of such diversion would be entirely to destroy the navigability for usefulness of Basswood lake.

JAMES J. DARCY.

Subscribed and sworn to before me
this 28th day of March, 1905.

WILSON J. CROSBY,
Notary Public, St. Louis County,
Minnesota.

EXHIBIT 'D.'

State of Minnesota, }
} ss
County of St. Louis. }

Richard H. Fagan being first duly sworn says that he is now and for the past twenty-two years has been a resident of the County of St. Louis; that the affiant became interested in timber and iron lands located in the Counties of St. Louis, Lake and Cook; that during all of the aforesaid period of twenty-two years the business of the affiant has required that he should himself get first-hand knowledge of the facts relating to the natural features of said three counties by observation upon the ground; that in the course of his said work the affiant's special attention has been directed to the northern part of said counties lying near the Canadian border; that it has become necessary in connection with the affiant's timber and iron interests to make a study of the natural flow of the waters running northward and emptying into the streams along the Canadian boundary as a source of waterways for getting logs to market; that the affiant is thoroughly familiar with the water courses and with the lands in the Counties of St. Louis, Lake and Cook which are directly affected by the plans of the Minnesota Canal and Power Company; that during the winter the affiant has examined the topography of the country in which said lands are situated with reference to its timber and during the summer season with reference to its iron formation; that the affiant has made several trips to the north of Hunters Island (so-called) lying across the Canadian border in examining and selecting iron properties and is familiar with the topography thereof;

That the affiant is particularly familiar with Basswood lake and its tributaries and its sources of water supply;

That Basswood lake is a navigable body of water extending along the Canadian border for a distance of over fifteen miles and having several long indentations to the south; that all of these inlets are also navigable and the whole body of water has been used and is now being used for towing logs to a point located in Section 20-64-10 where they are transferred to a logging railroad and transported a distance of four miles to mills located on Fall lake; that a tug drawing six feet of water is now used for such purpose of towing logs and also for carrying freight over said lake; that Baswood lake empties into Crooked river and thence into Crooked lake;

That the said Basswood Lake, in the opinion of the affiant, derives $\frac{5}{6}$ of its water supply from Fall Lake waters; that practically all of such water supply comes through Fall lake except such as is received from the streams flowing southwesterly from the portage in Section 24 Township 66 North of Range 6 West of the Fourth Principal Meridian through Knife lake and Carp lake whose waters are adjoined at the portage located in Sections 1 and 2 Township 64 North of Range 9 West by certain waters flowing northeasterly through Moose lake and Newfound lake; that in the opinion of the affiant all of such waters including those just mentioned do not furnish more than $\frac{1}{6}$ of the water supply of Basswood lake;

That in the opinion of the affiant the permanent diversion of the waters emptying into Fall lake would destroy the navigability of Basswood lake; that the effect of any temporary holding back of the Fall lake waters is shown by an immediate lowering of the waters of said Basswood lake; that the formation at the outlet of Basswood lake on the west is such that the lake would be in a short time nearly drained by the permanent diversion of such waters;

That the affiant has carefully examined the plans of the Minnesota Canal and Power Company with reference to the diversion of waters proposed by it and is convinced that the carrying out of such plans would result in a practical destruction of the four following water powers: That upon Birch river in Sections 18 and 19 Townships 62 Range 11; that in Section 32 Township 63, Range 11, owned by the affiant and others; the Kawashachong falls located in Section 20 Township 63, Range 11; Curtain falls 18 miles north of Ely on the International boundary; that all of said falls have a direct, present and large value by reason of the neighbourhood of the mines of the Vermilion and Mesaba ranges on account of the possibility of the use in such mines of the electric power which can be produced from said water powers; that the iron bearing property of the affiant and others located in Section 30-63-11 could be operated entirely by the electric power which could be developed from the water power located in Section 32 above referred to; that the City of Ely located only a few miles from the two largest water powers above noted has a present demand for a large part of the power that could be developed from the largest water power above mentioned; that most of the mines located on the Vermilion and Mesaba ranges now use steam power produced from coal brought from Pennsylvania, transhipped either at Duluth or Two Harbours and conveyed by rail a distance of 100 or 125 miles; that the large cost of such steam power renders the aforesaid water powers not only available but exceedingly valuable; that one of the purposes of the Minnesota Canal and Power Company is to bring the water to Duluth, convert it into electric power and then take the power back 150 miles to these ranges; that in the opinion of the affiant such a destruction of natural water powers for such a visionary scheme should not be permitted by the Government.

RICHARD H. FAGAN.

Subscribed and sworn to before me
this 31st day of March, 1905.

H. H. HOYT,
Notary Public, St. Louis County,
Minnesota.

EXHIBIT 'E.'

State of Minnesota, }
County of St. Louis. } ss

Martin Dillon being first duly sworn on oath deposes and says: That he is a resident of said St. Louis County and that his business is that of a cruiser and explorer of iron and timber lands; that he began the business of exploring in the month of June, 1882, and has continued in such business ever since; that he is very familiar with the lands lying along the Canadian border, north-east and north-west of Fall lake; that he has canoed through the waters of the above territory and especially through Basswood lake and its various branches, the Crooked lake and Knife lake and is thoroughly familiar with the streams and lakes flowing northward which empty into Basswood lake through Fall lake; that Basswood lake is a navigable body of water extending along the Canadian border for a distance of over fifteen miles and having several long indentations to the south; that all of these inlets are also navigable and the whole body of water has been used and is now being used for towing logs to a point located in Section 20-64-10 where they are transferred to a logging railroad and transported a distance of four miles to mills located on Fall lake; that a tug drawing six feet of water is now used for such purpose of towing logs and also for carrying freight over said lake; that Basswood lake empties into Crooked river and thence into Crooked lake.

That Basswood lake derives its water supply from the following sources: From the streams flowing southwesterly from the portage in Section 24, Township 66 North of Range 6 West of the Fourth Principal Meridian through Knife lake and Carp lake and thence into the small stream located in Sections 1 and 2, Township 64 North of Range 9 West (Prairie Portage) where the waters are joined by certain waters flowing north-easterly through Moose lake and Newfound lake; that all of these waters are not large in quantity and do not drain any large tract of land for the reason that the streams upon Hunters island flow northward and for the further reason that the streams northwesterly from the divide in Section 24, Township 66 North of Range 6 West flow to the North of Hunters island; That Wind lake and Urn lake connect with southerly arms of Basswood lake by small creeks or rivulets but do not add materially to the volume of water in Basswood lake; that the same is true of the small area drained by a creek that empties into the westerly arm of Basswood Lake at a point near the dividing line between Sections 8 and 17 in Township 64 Range 11; that with the exception of these insignificant supplies last mentioned and the more considerable supply flowing from the north-east through Knife lake as above mentioned, Basswood lake gets all its water supply through Fall lake; that in the opinion of the affiant $\frac{5}{6}$ of the waters of Basswood Lake empty into the lake through Fall lake; that in the opinion of the affiant very great damage would result to the navigable capacity of Basswood lake by the diversion of the stream flowing into the same through Fall lake and that the final result of such diversion would be, entirely to destroy the navigability for usefulness of Basswood lake.

MARTIN DILLON.

Subscribed and sworn to before me this
28th day of March, 1905.

Wilson G. Crosby,
Notary Public, St. Louis County,
Minnesota.

EXHIBIT 'F.'

State of Minnesota,
County of St. Louis. } ss

William Shoop being first duly sworn says that he is a resident of the State of Minnesota and over twenty-one years of age; that his business for the past twenty-eight years has been cruising, exploring and lumbering; that during said time he has had large experience in all branches of the lumbering industry and as a cruiser and woodsman; that for the past six years he has been engaged in this business on the International boundary from Fall lake northward and eastward; that at the present time he has entire charge of getting the logs to the mill from the point where they are cut for a large logging firm doing business near the boundary on the American side; that the usual course of this business as now being conducted is to float the logs to Prairie Portage at the eastern extremity of Basswood lake whence they are towed a distance of about ten miles to Section 20, Township 64, Range 10 West where they are transferred to a logging railroad and transported a distance of four miles to mills located on Fall lake; that timber has also been taken under the superintendence of the affiant from other points on Basswood lake as far west as Townships 64-11 and 65-11 West of the Fourth P.M., and towed to the same point in Section 20-64-10 above referred to; that the affiant is very familiar by reason of the aforesaid lumbering operations during the past six years with Basswood lake and its tributaries over its entire extent; that the tug referred to above is the only steam vessel now navigating Basswood lake, draws six feet of water and is used for towing logs and carrying freight; that the extreme length of Basswood lake along the boundary from Prairie Portage on the east to the outlet into Crooked river on the west is over fifteen miles; that said lake contains in addition to the waters along the boundary several deep bays all of which are navigable to their extremity by the tug above mentioned and all of which can be used to float logs from the lands bordering thereon; that Basswood lake obtains its water supply through Fall lake, Moose lake, Snowbank lake and Carp lake; that in the opinion of the affiant three-fourths of such supply at least comes into Basswood lake through Fall lake; that affiant has often observed that when the dam located upon Section 20, in Township 63, North of Range 11 West was shut down the water in Basswood lake would in from twenty-four to forty-eight hours begin to fall at the rate of about an inch in twenty-four hours and would continue falling at this rate or somewhat less until the dam was raised; that the time during which the dam remained shut was never sufficient to enable the affiant to state what would be the extreme lowering which would result from permanently diverting the waters of Fall lake from Basswood lake but that in the opinion of the affiant such lowering would be approximately two feet over the whole area of Basswood lake; that there are reefs and bars at various points in Basswood lake which interfere to some extent with its navigation; that a lowering of the waters of Basswood lake two feet would very seriously interfere with such navigation.

WILLIAM F. SHOOP.

Subscribed and sworn to before me this
22nd day of March, 1905.

WILSON G. CROSBY,
Notary Public, St. Louis County,
Minnesota.

THE CHICAGO DRAINAGE CANAL..

The question of the Chicago Drainage Canal is dealt with in a report of the Commission which is to be found at page of this volume. Public hearings were held on the matter in Buffalo, N.Y., on June 26, 1906, and in Chicago, Ill., on October 17, 1906.

Meeting of the International Waterways Commission held at the office of the American Section, 328 Federal Building, Buffalo, N.Y., on Tuesday, June 26, 1906, 10 A.M.

Present: American Section Gen. O. H. Ernst, Chairman; Hon. George Clinton; L. C. Sabin, Secretary.

Canadian Section: Hon. George C. Gibbons; Hon. W. F. King; Hon. Louis Coste; Thomas Coté, Secretary.

Chairman Ernst: The Commission will please come to order. The first subject which we will take up this morning will be the Chicago drainage canal. Mr. Isham Randolph, the chief engineer, is present and the Commission will first hear from him.

Mr. Isham Randolph: Mr. Chairman, I think you are familiar in a general way with the sanitary work of Chicago. You know that this work is to the interest of the health of the citizens of Chicago. From the building of the City up to 1900 all the sewage discharged into Lake Michigan. From that lake the water supply of the city was also drawn. In 1886 Mayor Harrison appointed a Commission to consider the subject of Chicago's water supply. That Commission was headed by Mr. Rudolph Herring of Philadelphia. His associates were Mr. Samuel G. Artingstall, the City Engineer of Chicago, Mr. Benezette Williams and Mr. L. E. Cooley. (This statement is incorrect in that Mr. L. E. Cooley was principal assistant to the Commission of which Mr. Rudolph Herring was chief engineer and Messrs. Williams and Arlingstall members. L.C.S.) These gentlemen investigated the subject committed to them quite exhaustively; they prepared a preliminary report, which was published, and was to have been followed by a final report giving the results of all of their research. A change of administration brought a change of policy and the funds were never supplied for publishing this final report, so that we do not know what it would have contained. The preliminary report, as I remember—it was only in 1900 that I first saw the preliminary report; I found one of the original members had a copy of it and he loaned it to me to read. As I remember that report three things were considered; they considered the advisability of putting an intercepting sewer along the Lake front which would collect all the sewage of Chicago and conduct it to the extreme end of Lake Michigan where it was to be pumped into the lake; the intakes from which the water supply was to be derived was to be situated as far as was consistent and reasonable, thus divorcing the source of supply from the source of pollution as far as possible.

As an alternative to this it was proposed, instead of pumping the sewage back into the lake, to establish a land disposal system and pump this sewage on the land. The estimated cost of this, as I remember, was something like $75,000-000,000, with an annual maintenance cost of $2,000,000.

The third alternative was that of reversing the Chicago River and discharging it into the Desplaines river at a point in Will county about 28 miles south of Chicago.

The divide between the watersheds of Lake Michigan and the watersheds of the Desplaines and Illinois Rivers, was a very low point; the lowest place in this divide was 11·72 feet above Chicago datum Chicago datum was low water of 1847, or, rather, it was a datum plane established by the engineers who built the Illinois and Michigan Canal. That canal was commenced in 1836 and opened for navigation in 1848, and it so happened that the low water of 1847 coincided with the datum plane established by the engineers of the canal.

After the dissolution of this Commission the agitation continued, until 1889 legislation was procured from the State of Illinois authorizing the establishment of Sanitary districts, who should be empowered to take water from Lake Michigan for the purpose of sanitation. This sanitary district law provided that any sanitary district taking water from Lake Michigan should provide a flow equivalent to 20,000 cubic feet per minute for every hundred thousand inhabitants draining into the canal. The Sanitary districts of Chicago was organized in December, 1889; the Board consisted of nine members elected by the people of the Sanitary district. This Board had very large powers. It could levy taxes, levy them of course by the law which created the district the original proposition being that the tax levied should be one-fourth of one per cent upon the assessed valuation of the property within the district. They were permitted to sell bonds up to a limit of five per cent of the assessed valuation of the district.

With these powers, the district proceeded, the trustees proceeded to buy a right of way from Chicago to Joliet. They perfected a plan for this channel there in 1892, on the third day of September, the first ground was broken on the county line of Cook County. The work progressed until it was almost entirely completed in December, 1899. At this time we learned that there was a decided movement on the part of St. Louis to enjoin the opening of the channel, to go before the United States Supreme Court and prevent the opening. On the 16th of January, 1900, we learned that they had actually sent their representatives to Washington to sue out this injunction before the Supreme Court. On the morning of the 17th we succeeded in getting permission from the Governor of the State to open the channel, and on that morning the dam was lowered and the flow of water from Lake Michigan to the Gulf of Mexico commenced and has continued ever since.

As you are well aware, the low stage of water in the lakes is in the winter months. Opening in January the water began to flow when the lake was at its lowest stage. The water rose to its maximum height the following summer. Of course had the reverse been the case, the unthinking public would at once have charged the sanitary district with lowering the lakes; if we had opened in the summer time and the lakes receded according to their fixed flow, we would have been charged with the recision at once.

I had no connection, at the time this law was passed, with the enterprise. I do not know how this volume of 20,000 cubic feet of water a minute per hundred thousand inhabitants was arrived at, other than I have learned from Mr. Cooley, who was at that time connected with the district and very largely responsible for the passage of the law. I have learned from him that it was the result of exhaustive examination of reports based upon research made by scientists in England and on the continent, and as the result of that research, 20,000 cubic feet per minute was agreed upon as a proper volume. I have made no personal research in this direction.

Prior to the opening of our channel we arranged with the University of Chicago and the University of Illinois to make a long series of tests of water in the Illinois-Michigan canal and the Desplaines-Illinois river, to determine the condition of that water both chemically and bacteriologically.

After the opening of the channel the tests were made and carried on for the same period. They were very exhaustive, probably the most exhaustive investigations that have ever been made in that direction. Those results are all published and are all available and any of you gentlemen who care to have copies I would be glad to furnish copies to you. As I say, I have made no personal research in this direction. Some months ago a gentleman from New York, who is very well known in the scientific world, wrote us for a copy of these tests, Mr. Allen Hazen; you all know him; and recently on April 30th, he wrote me the following letter:

"April 30, 1906.

" Mr. Isham Randolph,
" Chief Engineer Chicago Sanitary District,
" Chicago,, Illinois.

" Dear Sir,—Some time ago you kindly sent me data as to the flows and population tributary to sewers reaching the Chicago Drainage Canal and the Illinois and Michigan canal. These I have combined with the published analyses for the years 1900 and 1901 in The Chemical Survey of the Waters of Illinois, 1903, and in Report of Streams Examination, 1903, and have made the following computations. In computing these amounts the normal amounts of the various substances present in Lake Michigan water have been deducted in each case.

YEAR 1900.

Population contributing 1,443,789.

	Kilograms Per Day.			
	Illinois & Michigan canal.	Main drainage canal.	Total for both canals.	Grams per capita daily.
Chlorine	143,900	84,000	227,900	157
Free ammonia	14,350	12,200	26,550	18·4
Albuminoid ammonia	2,020	2,475	4,495	3·1
Organic nitrogen	4,135	6,590	10,725	7·4
Total nitrogen	–	–	37,000	25·6

YEAR 1901.

Population contributing, 1,494,300.

Chlorine	169,500	90,950	260,450	174
Free ammonia	20,310	17,400	37,710	25·3
Albuminoid ammonia	1,080	3,335	4,415	3·0
Organic nitrogen	1,969	9,018	10,987	7·3
Total nitrogen	–	–	47,633	32

" I am interested to see what a large proportion of the sewage was carried by the Illinois and Michigan Canal. The per capita amounts of the various substances are very much larger than is indicated by previous experience. For total nitrogen figures ranging from 12 to 15 grams per capita daily have been usually found for Eastern and European cities, when reckoned on the population actually tributary to the sewers; and for chlorine 25 to 50 grams per capita is all that has been indicated by previous experience. These figures refer to sewages which contain manufacturing wastes of various kinds: the figures for domestic sewages alone are 10 to 11 grams per capita daily for nitrogen, and 10 to 20 for chlorine.

'It seems then that the sewage from Chicago is about twice as strong, when judged by the chlorine, as the average sewage of the other manufacturing cities for which data are at hand. I am very much interested in this, and would like very much to find the cause of the excess. The stock-yards might possibly account for it, but if so, contributions from them must equal or exceed in polluting power the whole of the normal sewage from the city, if it is no stronger than other city sewage has been found to be.

"I am trying to put the data in shape so that the amount of the various polluting substances can be taken into account in figuring what must be taken care of, and with a view to applying the experimental results which we have to these quantities, and in that way perhaps getting a more accurate indication of the size of purification plants required than has been possible where only the volume has been taken into account. These results, while somewhat unsettling, because of the large variation from previous figures, are most interesting; and I am extremely obliged to you for the data upon which they rest.

"Very truly yours,

"Allen Hazen."

The original proposition was that the Chicago river should be reversed and its flow sent down the Illinois Valley. A channel capable of carrying 600,000 cubic feet of water per minute was constructed. The first seven miles of that, 7·8 miles, from Robey Street to Summit, is not of full capacity; that portion of the channel was through clay which could be easily and cheaply dredged, so that provision was made there for only 400,000 originally; that is to be widened. The work of the Chicago river is now about eighty per cent completed, possibly a little more; the river has been widened 200 feet and deepened 26 feet. The depth at the dock is 16 feet and increasing to 26 feet 50 feet from the dock. The formulas by which these channels were figured were not adapted to channels of such large dimension and we find by actual measurement actual test of the flow, that the channel has a greater capacity than it was figured upon. The main channel can easily carry over 800,000 cubic feet, instead of 600,000 as it was figured upon. If the only stream was discharging into Lake Michigan through the Chicago river the original project would have been sufficient. But in the city limits is a stream very similar to Chicago river, a stream which in dry seasons has very little flow. In dry seasons the current in the river is largely a question of wind. I have seen a very rapid current flowing up stream as the result of a wind blowing on shore from the lake. South Chicago has become to a large extent the main port of the city where most of its wheat and corn, products of that nature, coal, etc., are handled. That portion of the city is growing very rapidly; manufacturing plants are springing up all along the Calumet River. Sewers are being built discharging into this river. Everything points to the time when that river must be reversed as the Chicago river has been, if the water supply of Chicago is to be preserved intact. This is not a necessity today. At present the sewage flows into the river, lies there until there comes a freshet to sweep it out into the lake; then a very foul condition is created within quite a radius to the mouth of the river. Those who have charge of this work must look to the future as well as to the present. We must see the time when this region will be a populous one just as the main city of Chicago is today, and make provision for what is to come, and not only the sewage that is created in our own state of Illinois, but just across the border in the State of Indiana immense industries are being developed, vast populations are centering there and the topography is such that this sewage drains into the Calumet river and we must not only take care of the pollution we create ourselves but the topography of the situation compels us to take care of the pollution created by our neighbors as well. These things are things of the future. Three years ago we went before the Illinois Legislature with a bill which authorized the reversal of the flow of the Calumet river and the building of a canal from the north branch of Chicago river through Evanston so as to take care of all the sewage that was created in the northern suburbs as far as the county line of Cook county. This canal has to be fed by pumping, the lake being at the same elevation at Evanston as it is at Chicago and there will be no flow, simply a stagnation if we did not pump it; so if you establish at Evanston a pumping plant of 60,000 cubic feet of water per minute which is pumped into this canal, this discharge comes in the north branch of the Chicago river, the north branch meets the main branch of the Chicago river near Lake Street, what is called the Forks, about a mile in from the lake front. The south branch of the Chicago river is being improved to care for a flow of 480,000 cubic feet of water per minute at a velocity of a mile and a quarter per hour. The Evanston canal will come into this south fork, hence the flow through the main river will be diminished by just the amount of the contribution from Evanston, because the flow of the two coming together must pass through this 480,000 cubic foot channel, so that what comes from the northwest must choke off a corresponding volume coming directly in from the lake, so that that canal does not take any more water from Lake Michigan than would flow through the main river if it was not constructed. It is proposed to take through the Calumet channal, when built, about 240,000 cubic feet of water per minute; that is about as little as we could get along with, and also as much as we could take care of through our main channel. These are the plans of the district, gentlemen, and you are as familiar as I am with the conditions of the great lakes, and I do not know that I could say anything with regard to that, but it may be interesting to you to see a chart prepared from data collected by the United States engineers, showing the fluctuations on the lakes for long periods of years. (Hands a blue-print to each member of the commission.) Unless you have some question to ask, which I may or may not be able to answer, I am through.

Chairmain Ernst:—Mr Randolph, one of the essential points is the necessity for these quantities of water. Assuming that you have once reversed the flow—you have done that now with the Chicago river, and it is a comparatively easy matter to do it with the other; after it had once been done, the water supply of Chicago is protected. The question after that is the dilution of the sewage.

Mr. Randolph:—Yes, sir.

Chairman Ernst:—So far as the water supply of Chicago is concerned, it is protected the moment you have reversed those flows.

Mr. Randolph:—Chicago is protected. The question is, how much of a damage there is to the people below us.

Chairman Ernst:—The doubt in my mind is, where is the authority for taking these quantities called for in the State law; can you give us any light on that? You have touched on it rather lightly.

Mr. Randolph:—I touched upon it lightly, due to my ignorance.

Chairman Ernst:—After the water supply is once protected, the main thing then has been accomplished, and after that it is a question simply of the City of Joliet,—is there anybody else?

Mr. Randolph:—The City of Joliet and in the Illinois valley, all down through there.

Chairman ERNST:—They are protected sufficiently by the time it gets down there.

Mr. RANDOLPH:—I do not think that Peoria will have anything to fear.

Commissioner GIBBONS:—I did not quite understand what was the estimate you thought would be required when you get the works completed, how much per second?

Mr. RANDOLPH:—About fourteen thousand cubic feet per second.

Commissioner COSTE:—What are you going to do when you reach the limit?

Mr. RANDOLPH:—Sufficient unto the day is the evil thereof. I hope somebody will develop something by that time to help us out.

Commissioner COSTE:—What is the limit, Mr. Randolph?

Mr. RANDOLPH:—The limit to what?

Commissioner COSTE:—The limit to the amount of water that you can take care of.

Mr. RANDOLPH:—I think the limit will be reached when we take what we are asking for,—14,000 per second.

Commissioner COSTE:—That would be the ultimate limit?

Mr. RANDOLPH:—Yes.

Commissioner GIBBONS:—Have you provided for the use of any of this water for power purposes?

Mr. RANDOLPH:—Yes, sir.

Commissioner GIBBONS:—Does not that necessitate the use of a greater quantity of water?

Mr. RANDOLPH:—No, sir.

Commissioner GIBBONS:—Will you explain that? That is one of the objections to the scheme, that you are asking for it for power purposes.

Mr. RANDOLPH:—At the time that I took charge of this work thirteen years ago, after I had a chance to grasp it, I saw in the vicinity of Lockport there was an opportunity to develop a great water power. I came on the first vacation I got to Niagara and spent a few days there with the engineers and the electrician. I went back and made a report to my board of the possibilities, and the report was read, and one man got up and wanted to know what business I had running around the country looking after water power that I was employed to build a drainage canal; and another jumped up and wanted to know what right I had spending money of this district looking after water power, that was entirely beyond my jurisdiction. I said, "Gentlemen, I haven't spent a moment of your time nor any of your money. I have spent my own time and my own money; but the time will come when you will appreciate this report." My idea was this, that here was a great waste of power; the people had spent millions of money to create this channel; there was a possibility of recouping in a small way for this great outlay. And I finally got my people to recognize these possibilities and get permission from the State of Illinois to develop this power. Now, the water is there whether we use it or not.

Commissioner GIBBONS:—Do you not use more by that?

Mr. RANDOLPH:—No, sir, not a gallon more. This same idea occurred to our Congressman, and I had a letter asking if we didn't want this water for power purposes? I wrote him a statement and I told him I thought we could hardly afford to pay twelve hundred dollars a horse power for water.

Chairman Ernst:—The only point in mentioning that at all would be this, in having a channel once constructed, it would be a natural thing to use it for the total capacity. You never would build a channel for that purpose, but having it built, you might find it would carry more water than the sanitary necessities might require and you might use it for power purposes.

Mr. Randolph:—Yes, sir.

Chairman Ernst:—Your idea is that fourteen thousand cubic feet a second is the limit that can be used in this method of disposing of the sewage; if you have more population and that isn't sufficient, you have got to do something else?

Mr. Randolph:—Yes, sir.

Chairman Ernst:— The Commission would like to hear from Mr. Weller, the commissioner of the Department of Canals.

Mr. Weller:—Mr. Chairman, the proposition of the Chicago sanitary district as laid down by Mr. Randolph this morning neglects altogether to mention the effect of the withdrawal of this water from the lakes, that is, the effect on the navigation.

The Dominion of Canada has spent a very large sum of money in building canals. Commencing in 1829, the Welland canal was completed, and since then they have spent some seventy-five or eighty million dollars in perfecting the canal system. The withdawal of this water from Lake Michigan will, I am satisfied, lower the level of the lakes a certain amount, how much I am unable to say, but there is no question whatever in my mind but that it will lower it some, and in doing so it will affect our canal system, not only on Lake Erie as represented by the Welland canal, but I believe more so down the St. Lawrence canals. Computations have been made I believe showing the water will lower in Lake Erie from four to seven inches. Either one of these lowerings, if permanent, would be disastrous to the Welland canal. We have barely water enough now, owing to the gradual lowering of the mean level of the lakes in the last few years, irrespective of the Chicago drainage canal, and we have spent in the last five years some million or more on the upper level of the Welland canal to deepen it to what has become the normal, to give us working depth at the normal level of the lake, or in fact, low level. We have not quite accomplished this at the very lowest stages, but nearly so.

The St. Lawrence canals will I consider be very much affected by this withdrawal of water, even more so than the Welland canal.

I understood Mr. Randolph to say that the withdrawal of the water would not affect the lakes. Now, that doesn't seem to me to be reasonable at all, for any one to bring up such a proposition. The level of the lakes, as I understand them, depend entirely upon the relation between the amount of water flowing through them, and the area, the shape of the barrier or the orifice at the barrier, for instance, at Buffalo. The amount of water which flows down there and the shape and area of the opening regulate entirely the level of the lake. If you reduce the water flow, you must lower the lake level. The question of how much is a matter of calculation which engineers may or may not be able to make accurately. The same thing occurs in the lower canals, and in such a large number of places down there. Here we can regulate Lake Erie in one spot; but down on the lower canals, there are probably six or seven different places which are affected, different canals, and I think that in any proposition to withdraw water entirely from the lakes, that some arrangement should be made, before any privilege is granted, by which the levels of the lakes and the rivers will be kept up to protect the Department of Railways and Canals in the large expenditures that they have made; that is a question that should be very seriously considered.

I remember in 1895, at the time of low water, very low water, that had there been a withdrawal then of five per cent of the flow or seven per cent, as this fourteen thousand foot represents, we would have had no navigation whatever; as it was, we had very little. Since then the canals have been deepened, but not enough to provide for those very low stages.

We did not anticipate many years ago that the lakes would lower as much as they have. 1895 was an exceptionally low year, I think much below any previous records, and our new canal system was then already designed and nearly finished, consequently we did not provide for this new low stage. If we have that stage again, with an extra reduction of water diverted caused by the diversion through the Chicago drainage canal, I am afraid we will be in very bad shape and I think this matter should be taken into serious consideration.

Mr. RANDOLPH:—You entirely misunderstood me if you understood me to say that I did not believe that this would affect the lakes. I do not see how you could take water out of a vessel without affecting its level, but this fact remains, however, that we have been drawing water for six years from the lake, and the lake has been rising all that time; the six years that we have been using this water show a higher stage than the six preceding years, which of course is simply an excess of rainfall, or, the thing which Gen. Ernst and his associates call attention to in the report, may have happened; they state that in severe winters the discharge into St. Clair river is choked and the amount of water is accumulated in Lake Huron and Lake Michigan which is about equivalent to the volume taken by the sanitary district canal. If that is true, then of course the canal would not affect the level during that period; if there comes a low water period, the canal will affect it.

Commissioner CLINTON :—Mr. Weller, will you permit me : You stated something in reference to water taken from the upper lakes which would affect their level, unless steps were taken to compensate—that was not in your language ; But I would like to know if you have any means of compensation to suggest?

Mr. WELLER :—No, I may say that I haven't figured out any means. I am satisfied, however, that means can be adopted.

Commissioner CLINTON :—I mean generally : I do not mean any specified means such as an engineer would make ; but the points at which compensation could be made?

Mr. WELLER :—Yes ; compensation I consider would have to be made at Buffalo and Cardinal, between Prescott and Cardinal, and near the head of every canal down the St. Lawrence.

Commissioner CLINTON : Could it not be made on the St. Clair, for the upper lakes?

Mr. WELLER :—Yes. But we are not particularly interested in them that I know of ; we have nothing up there.

Commissioner CLINTON : Not at present.

Commissioner COSTE : He is only speaking for his Department. His Department has not canals above the Welland. Of course it would help Georgian Bay.

Commissioner CLINTON :—Your idea is that compensation could be made at Buffalo?

Mr. WELLER :—Yes ; and for Lake Ontario and the river stretches.

I may say in reference to Mr. Randolph's remark that the lake has been rising, it certainly has ; but if Mr. Randolph will study the record he will find it did not rise like it did in the cycle of years previously, and they have not been lowering it enough to stop the rise altogether. Another reason why the lake should not have risen, but it hasn't risen as formerly ; in 1904 and 1905 the water.....

Mr. RANDOLPH :—I might say that Lake Michigan hovered around datum.

Chairman ERNST : That is such a complicated question. Up on the wall there is a record for sixty years.

Mr. RANDOLPH :—This summer it stands in Chicago about a foot and a half above datum,—a foot and four-tenths above datum.

Mr. LIVINGSTONE :—This fourteen thousand cubic feet per second, did I understand you or did I not, Mr. Randolph, that taking fourteen thousand cubic feet per second would or would not lower the level of the lake.

Mr. RANDOLPH :—As I before stated, I cannot see how you can take water out of a vessel without lowering it to a certain extent ; and how much that is compensated by rainfalls and by the choking of the St. Clair River, etc., as alluded to by this gentleman, I am not prepared to say.

Mr. LIVINGSTONE :—I want to say this, that as far as the Lake Carriers positions is concerned, I would like to make it just clear for a moment. These engineering questions and problems I am not competent to talk upon, because I am entirely at sea regarding them and we prefer to leave that to the intelligence of the United States engineers to determine in whom we have full confidence. But let me ask you a question : This twenty thousand cubic feet would cover what population?

Mr. RANDOLPH :—Four million two hundred thousand.

Mr. LIVINGSTONE :—I want to say, by way of preface, that as far as the Lake Carriers Association is concerned, we feel of course that whatever water is necessary for the sewage and drainage of Chicago and for getting pure water for the present condition of health, we feel that they ought to have it. But when it goes beyond that, goes into navigation purposes and great projects to build up a course of navigation that would tend to benefit the residents of Chicago and make it a great City at the expense of lowering the lakes and injuring navigation and injuring the balance of the country, that we are naturally opposed to it. As far as any figures are concerned, I do not assume to say that they are correct ; but figures that we have had from United States engineers and men of acknowledged ability. without assuming that their figures are absolutely correct, it is very natural that it should raise very strong doubts in our minds and grave fears as to what the results will be to take the fourteen thousand cubic feet per second. Government engineers have said that in the course of time (not the first years ; but I mean for the two or three years) might result in the lowering of the water on Lake Michigan and Lake Huron are considered in the same pool; there is practically no difference between them ; I believe the gauge shows a little difference of four or five one-hundreths of a foot, but not to amount to anything) must amount to eight inches, and on Lake Erie seven inches. Understand, I do not say these figures are correct, but they are statements made to us.

Now, take our modern carriers, all the boats built at the present time, modern built boats, they will carry on an average about one hundred tons per inch; so that you can readily see that if the water was lowered say eight inches (I merely use that as an illustration), if the water was lowered eight inches, it would result in cutting off eight hundred tons carrying capacity of each boat, a very low estimate that is, more than a conservative estimate, because all the modern boats average that. Taking twenty trips per season, and I guess twenty-two would be a fair average ; but call it twenty, that would make a difference of sixteen thousand tons per season ; and take the rate of ore, at seventy-five cents per ton from the head of the lakes, and deducting from that twenty cents per ton (of course what you didn't carry you wouldn't have to pay for unloading) deducting the twenty cents per ton, see what an enormous loss it would be to the great tonnage of the lakes. The smaller classes of boats are rather becoming obsolete so I refer now particularly to the modern class of boats and you can see what an enormous loss it would be and the constant loss it would be to the great public in the diminution of the carrying capacity of freight. For instance, I think last year approximately (is practically correct,) I think the average cost per ton per mile of freight on the lakes was about $\frac{85}{100}$ of a mile per ton per mile; and I think that the lowest rate—I know that this Commission at all events, if I am not mistaken, have fixed the average rate of rail freights per ton per mile at four mills—

Commissioner CLINTON :—Not less than four mills.

Mr. LIVINGSTONE :—I think with the exception of the Lake Shore road and possibly one other road ; I think there are only one or two railroads in the United States that you can get down to that amount ; so that on those figures it was estimated that our lake carrying freights last year would figure up a saving of $116,000,000,—and that would amount to considerable more than all the money which has been expended by the government in the improvement of lake channels since the creation of the government, so to speak, to the present time. I merely call your attention to these facts to show you how grave a matter it really is to the great public generally and the navigation interests of the Great Lakes. Professor Johnson of the Panama Canal estimated not a great while ago, in making report, if my memory serves me right, he estimated that after the Panama canal had been completed, and been in operation for ten years, that ten million tons freight would probably pass through it. That ten million tons of freight, net tons as I understand it, passing through the Panama canal ten years after the canal had been completed. Assuming that his estimate is correct and his figures are correct, this amount is less than the increase in tonnage alone on the great lakes last year, and only a 230 day year, as against 365. In other words, the tonnage last year, the increase in tonnage carried on the lakes last year alone was almost eleven million tons. And I merely want to call the attention of the Waterways Commission to this fact ; I do not propose to discuss engineering questions, because I cannot. But naturally this proposed fourteen thousand cubic feet of water, with the information we have from government engineers, has aroused our fears to quite a large extent ; and while I want it clearly understood we favour Chicago having all the water necessary for its sewage and drainage and the preservation of the health of its people, we want that to be the limit ; we do not want, in other words, an amount of water diverted that will provide, for instance, for a great navigation channel by which you shall go on still further and build nine or ten locks and build them with fourteen feet over the sill and build them in such a way that you ultimately can deepen to twenty-five feet, and no telling how large in the end it may divert the water on the lakes. I simply want to put these matters before you ; and we decidedly object, and the lake carriers themselves decidedly object to giving you fourteen thousand cubic feet per second.

Chairman Ernst :—Mr. F. King is here representing the Dominion Marine Association. The Commission would be glad to hear from him.

Mr. King :—Mr. Chairman, I have the honour to represent the Dominion Marine Association, which, like the Lake Carriers Association of the United States, represent the tonnage upon our side of the line. I can say that we represent practically all the freight and passenger business from Montreal to the head of the lakes in Canada, and I would like promptly to disabuse your minds and the minds of the Commission that I am here to offer suggestions or advice of any kind to a body that has the experience and expert knowledge that this Commission has. We are here, through myself, to show that we realize the importance of the question, and to ask the Commission to give it the most careful and serious consideration, and I am here in a receptive capacity to learn what I can to-day. I do not go quite so far as Mr. Livingstone does, and I scarcely think my association would, as to say that Chicago must have all the water that may be necessary for sanitation purposes without reference to the extent of that amount. I would say that in the first instance the great lakes and the rivers represent for both countries a waterway that the people have a vested right in that cannot be interferred with for the benefit of one section. Do not let me be misunderstood. If it were possible for one city to devise a scheme of this kind which would lead to a proper sanitary drainage system without interfering with such a right unreasonably, we would be only too pleased to have it carried out; we would join hands at once with the lake carriers in saying "Let the work be completed and extended;" but I would think that the views of my association are that primarily navigation purposes must be looked to, and that when, as Mr. Randolph has pointed out, three schemes were under consideration, one, to divert the sewage, one to have a land disposal system, and another a drainage system, that the question of expense ought not be allowed to decide entirely in favor of the system that has been adopted at the possible expense of navigation to the seaboard. We are one with the lake carriers in the whole matter representing the tonnage of the lakes, and we ask the Commission as we have already asked you on a previous occasion, to give the matter the most careful consideration and to obtain that expert advice which will enable them to decide whether or not the levels below will be materially interfered with; because, as Mr. Weller has pointed out, the Welland canal is now in just such a position where it is a very close question whether we have the fourteen feet ; we are told that we can load fourteen feet, and we are told that that means really fourteen feet of water and perhaps we better get down to thirteen feet nine or thirteen feet eleven ; perhaps we can steal an inch or so now and again and take a risk. But the variation of a few inches in the levels is going to make a decided difference on the Welland, as Mr. Randolph probably will admit, and perhaps make more material difference down the St. Lawrence canals, and we feel that we are not speaking only for Canada ; that we are in the same position as those on Lake Erie ; It is a question whether a vessel can get into the Harbor at Port Colborne or the lower ports, or the larger ones get into Buffalo or Cleveland or other points. I am sure the Commission realizes the fact fully that the navigation interests ought to be protected in this way, and I am merely here to say we appreciate the opportunity to be here and thank you for the opportunity, and to hope that the matter will have a very careful investigation before any extension of the powers to Chicago are permitted ; and possibly the whole question ought to be looked into as to the amount that is now being withdrawn. Certainly we would say that the power ought not to be extended to the extent where they are creating new waterways.

Mr. Livingstone :—At the Lime Kiln crossing so far this season the average has been at least two inches lower than last year. Sometimes according to the wind we have some fluctuation there ; when the wind is from the southwest it will lower the water, and the east to some extent will raise it ; but take the normal stage, it has averaged so far two inches less this year than it was last year.

Chairman ERNST:— The Buffalo Chamber of Commerce are represented here by Captain J. J. H. Brown.

Mr. BROWN:— Mr. Chairman, I was hastily summoned here or asked to come here. I am not prepared to speak on this subject; I have a general knowledge of lake commerce with which I have had more or less to do all my life. In Buffalo what we are concerned in is not the sanitation of Chicago, but the preservation of our lake levels and the conserving of the interests of lake navigation. I cannot agree with my friend Mr. Livingstone to that we are willing that Chicago should take all that is necessary. He does not say who shall judge of its necessities for sanitation or any other purpose. There is a vast population there now of two millions or more, and it is growing wonderfully. The whole head of Lake Michigan will be densely populated in a few years. There is a new harbour being created in Indiana where there will be a hundred thousand people and a manufacturing city, and the whole region is a dead flat; the difference of elevation between that and the Mississippi valley is very little, and if it is necessary to take the large quantity of water spoken of here now to make clean Chicago river, as much of it as it made clean— the south fork of the south branch you could bail it out with a fork, and filth from the stock yards has filled that up, and literally you could bail it out with a fork. Now, it isn't a wild guess or a prophecy to say that there will be six million people at the head of Lake Michigan in a short time. I do not know how much water they want for sanitation, but I have read of other methods of disposing of sewage or making it innocuous, without running it into some one's else drinking water. And if Chicago may use unlimited quantites of water, and the adjacent region, why may not Milwaukee? Milwaukee has the same problem before it, although it isn't quite as handy to get into some river to take care of it. Then there is the great and growing city of Cleveland; it would be an up-hill job to get into the Ohio Valley, but it is not an impossible problem. They have run channels further out into the lake and they haven't got out away from the typhoid fever germs yet. And Toledo is a rapidly growing city; drains into the Maumee; it would not be much of a trick to turn that up hill as the Chicago River is turned up hill; and so it goes. Where is the end to be? I still think it would have been better to say they must find some other more scientific way to dispose of it than to run it into the Mississippi, drawing water from the lake to carry it along. I do not think that I have any right to speak on this subject, any authority as representing the Chamber of Commerce, except so far as it affects the navigability of the lake. That is a very important matter to us. I think the gentlemen who have given so much thought to this matter are eminently qualified to deal with it and will deal with it wisely.

Mr. LIVINGSTONE:—There seems to be a misapprehension. I did not mean to be understood for a moment that Chicago or any other city should be allowed to take water *ad libitum*, indiscriminately. I took it for granted that I would be clearly understood that they should remain in the future, as in the past, directly under the control of the United States engineers and that the whole subject should be guided by reason and good judgment so as to try and not have it interfere with navigation. Up to the present time, if I understand the matter correctly, they have used about 4,167 cubic feet, and when they come to jump from 4,167 feet to 14,000 cubic feet per second, it naturally makes us look around. But I did not mean to be understood that there should be no restriction of any kind. What I meant, and I supposed that everybody understood it, was that the matter should be in the future as it has in the past under the rigid supervision and inspection of United States engineers, and we have the fullest confidence in them in trying to protect navigation as well as having due consideration for the city.

Commissioner Gibbons:—Might I ask Mr. Randolph now whether it would be a question of expenditure of money to provide some other means? There is one point I would like to know Mr. Randolph's opinion on, whether any other means could be devised for the preservation of the health of Chicago, at an expenditure of money, or whether this is the only one?

Mr. Randolph:— I do not know of any other means within the financial ability of the city.

Commissioner Gibbons:—Might I ask one more question? I think everybody in the whole country is agreed that it is very desirable to preserve the levels of the lakes, and if it were a question of money, it might be a question for the nations to assist, rather than lower the level of the lake. I want to know whether there is any scheme by which, with an expenditure of money, your sanitation could be taken care of without interfering with these levels, which you admit must be the effect, of this scheme? Is it a mere question of money? If it is a mere question of money, I do not think there is any expenditure of money that would not be justifiable.

Chairman Ernst:—I think my recollection of that report is perhaps a little fresher than Mr. Randolph's; I read it not long ago; and it was the opinion of that committee that there was no other way. This seventy-five or seventy-eight millions was for a partial remedy; it was only a partial remedy.

Mr. Randolph:—It was for a time only.

Chairman Ernst:—Is there any other gentleman who wishes to address the Commission on the Chicago drainage canal? If not, hearing on that subject is closed.

PROCEEDINGS

At public hearing of the International Waterways Commission, held at Chicago, Illinois, October 17th, 1906, in Room 510 Federal Building.

PRESENT : The American Members of the Commission, General O, H. Ernst, Chairman, Honourable George Clinton, of Buffalo, N.Y., Mr. E. E. Haskell, Engineer. The Canadian Members of the Commission, Honourable George C. Gibbons, K.C., Chairman, William F. King, Esq., Geologist, Louis Coste, Esq., Engineer. Mr. W. E. Wilson, Secretary of the Commissioners for the United States and Thomas Coté, Secretary of the Canadian Section.

Chairman Ernst called the meeting to order at 10 o'clock a. m.

General ERNST (Chairman):—Gentleman, the Commission have come to Chicago at the request of representative citizens to hear anything that you might wish to say to us concerning the sewage disposal of the City. You all know pretty well what the state of affairs is. It is not necessary for me to go into any very great details. I have here a list of prominent bodies in the city who wish to present some arguments or statements to the Commission. First, the Board of Trade. Who is representing the Board of Trade? Nobody seems to be present.

(Subsequently Mr. B. A. Eckhart, representing the Chicago Board of Trade, addressed the Commissioners.)

The Chairman then called the name of the Merchants Club of Chicago, whose representative stated that the Merchants Club desired to present resolutions similar to the resolutions which Mr. McCormick, President of the Chicago sanitary district, would ask the filing, and stated that such resolutions over the position of the Merchants Club.

The Chairman then called the name of the Illinois Manufacturers Association.

Mr. WILLIAM DUFF HAYNIE (Representing the Illinois Manufacturers Association):—The Illinois Manufacturers Association, gentlemen, is a body of about 950 members, the membership representing different industries. While it is a state organization the great majority of its membership is in Chicago, and it is, therefore, slightly interested in this question which is before you to-day and as we recently learned has been before you for a long time. As a part of the people of Chicago, the people who are interested mostly, the people on the lake, we have prepared resolutions which will be presented to you, and, perhaps, there may be a few things which I should say in its behalf. It may be true—I do not feel competent to pass upon that question myself—that Chicago's undertaking to get pure water for her two millions people has not been wise. I do not know but those who have had the interest of the city at heart, in the early days when this was started, after they had studied the whole situation, believed that that was the best way and the cheapest way, the way the people could be benefited most, by giving the people of Chicago pure water.

Like all great enterprises, like all great efforts for the benefit of the people, this has grown and grown on our hands until the people of Chicago have got more money invested in this than they ever thought they would have. But as they look back from their present standpoint to their past position they do not feel that they have made a bad investment, because the health of the city has been greatly benefited in all respects, and especially in regard to those diseases which are directly the result of impure drinking water ; and while, as I say, they have spent more money than they ever thought of spending, they feel it is money well spent. It seems to be a kind of habit, if I may say in passing, for us American people to go into great enterprises, believing they will cost only so much and find, when we get through, the cost has been a great deal more than we anticipated.

Here is Chicago, with its two million people, dependent at the present time upon the success and the continued successful operation of this drainage channel for the health of its citizens. It is not only that there are two million people here, but there is a stake for the future—not now, but for the future, there is at stake not only the further development of this city here, with all the country that is tributary to it, but there is at stake all the organization of industries, of processes of distribution, the railroads, the commerce of the boats and all those things, are dependent upon Chicago's ability to continue to grow and to be. If fifty years from now, we are going to have to return to the conditions which existed twenty years ago, it is merely a matter of a short time when a big black circle can be drawn around Chicago, and on and within it will be stamped "The Typhoid District of America." Now, how long will a city last under these conditions? We cannot carry it on, gentlemen, unless we can have, not only for the present but for the future, the assurance that the people of this great city can get pure water.

I saw in the papers this morning that some great stress had been laid upon the development of a deep waterway from Chicago to the Mississippi, and on to the Gulf. I know but little about that, except that I have always been in favor of it whenever it was mentioned. That proposition, gentlemen, is one which has grown out of simply the existence of a condition which was present, a thing which might be of value, which could be utilized for the benefit of mankind, going to waste. And so, having the water going into the Desplaines river and running from that river into the Illinois river and of sufficient volume to carry a man's goods from one town to another, we people in Chicago, being accustomed to realizing on all of the by-projects we can, simply said, "We will go to work and get Congress to help us take care of this which would otherwise go to waste." And so we have been developing all along the Mississippi valley and all through our state, with the idea that we are going to make use of this volume of water which, having done its work for the benefit of the people of Chicago, was going down through all this populous country in waste. That is an instance. We can get along without that if necessary, but we cannot get along without pure water for our people. That is what we have got to have.

After this waste water had cleaned the rivers of Chicago and given us pure water, there came a cry that we were harming them ; that we were endangering the lives of the people throughout that region, and in order for us to have the benefit of this great enterprise they had to be convinced that it was not detrimental to them ; and so the Sanitary Board has spent thousands of dollars to convince the people of the Illinois valley and the people of the Mississippi valley that no harm would come to the people in those great territories. We have done it up to a certain time. If conditions could remain as they always have been ; if Chicago could have no more people; if there would be need for no great greater amount of water, if the sewage and every thing would be all right, we would be in harmony with the people on the lakes ; we would be in harmony with the people along the valleys ; but there will come a time, with the increase of the population of the city and with its increased sewage, when we will have to have a greater amount of water going through our sanitary channel.

Missouri came and said, "You must show us," and we showed them. But the Supreme Court of the United States said : "for the present, gentlemen, there is no trouble between you and Chicago, because of danger from its sewage, but what the condition may be in the future we do not undertake to say." And the plain inference, therefore, is that if in the future we cannot be allowed sufficient water to dilute the sewage of Chicago, then St. Louis can bring its action in the Supreme Court of the United States and can stop the flow of the lake water through the sanitary channel. Then all our work and this great expense will have been for naught.

Gentlemen, I thank you.

General **Ernst**:—I will say for the benefit of the other speakers that they need not enlarge so much on the sanitary side of this question. The Commission has already accepted the sanitary canal to the extent of 10,000 cubic feet a second in their Niagara Falls report, and that limitation, which we supposed at the time was all Chicago asked for, or would want for many years to come, has brought out this additional demand for more water, not for the purpose of the Chicago Drainage Canal, but for the Calumet region. We want to be enlightened, if we can be, on extending this system to the Calumet region and to the suburban towns. The health and lives of the people of Chicago are understood to be too pre-eminent for the discussion. The next association on my list is the Commercial Association of Chicago.

Mr. **David R. Forgan**, President of the Chicago Commercial Association, spoke as follows:

Mr. President and gentlemen, I have not come here prepared to make any argument on behalf of Chicago as to why we should not be included in any recommendations your body will make, because that can be done very much better by others who have studied the question more than I have. I do not profess to be able to make such an argument. I come here, however, representing the Chicago Commercial Association, of which I happen to be president. I would like to say that that Association is composed of ever 1,200 of the leading business men, firms and corporations of Chicago; they represent at least 5,000 of the leading business men of this city. They are pledged to whatever will benefit Chicago from a commercial standpoint chiefly, but also, of course, from a moral and sanitary standpoint, anything that will benefit the city will have their consideration. They have, therefore, passed resolutions which go into an argument, to some extent, and which, I hope, will be carefully read by this Commission.

Not to insist too much on the health proposition of this city, I would like to read one clause of these resolutions, which shows the result of the opening of the drainage canal on the health of the people of this city. The concrete figures show that the effect of this improvement upon the health of the people of Chicago was positively immediate— that is the opening of the drainage canal.

Deaths from typhoid fever prior to the opening of the canal have been reduced in number from 37·4 per 100,000 population to 26·6, while deaths from diarrhœal diseases have been reduced from 167·4 per 100,000 population to 23·8. In general the result has been to make the death rate of this city lower than that of any other important municipality of the United States.

I am also here to represent the Chicago Bankers' Club, a body composed entirely of bankers of Chicago and adjoining country, even those outside of the state. They represent only the financial interests of the city, but in a matter of this sort they felt that they, also, should have a word to say, and they have passed resolutions which I hold in my hand, which I will submit to you along with those of the Chicago Commercial Association.

General ERNST:—We will now hear from the Chicago Board of Trade.

Address by Mr. B. A. ECKHART, President of the Chicago Board of Trade.

Mr. B. A. ECKHART:—President of the Chicago Board of Trade, thereupon addressed the Commission as follows:

Mr. President and gentlemen, I will read the resolutions adopted by the Chicago Board of Trade at a special meeting. They are as follows:

(Mr. ECKHART then read the resolutions, which are hereto attached.)

In presenting our views more fully I desire to say that which you are all, perhaps, familiar with: That the Chicago Board of Trade is one of the largest, if not the largest commercial body in the world. It is the distributing medium of the agricultutral portion of this country to the consuming portion of this country. Its business is such in extent that it has been considered in the past, and perhaps may be today—I am not quite sure about that—the largest medium of distribution in the world. The Chicago Board of Trade is interested in maintaining the lake level more than any other association or commercial body, because of its vast shipping interests. But the Chicago Board of Trade realizes that no community, city or state or large municipality can long exist without a supply of pure water. It is more essential to the health and welfare of a community than even pure food. The people of this city, as you are aware, have had this problem before them for many years. It was one of the most difficult problems that the city of Chicago ever had to deal with, to secure pure water and perfect drainage, without which, as I have stated, no community can exist for a very long period of time.

The present channel was the result of agitation on the part of the people of the City of Chicago that took place many years ago, after it was found that if we should continue to discharge the sewage into the Chicago River and it continued to flow into Lake Michigan and drift out into the intakes, that ultimately it would pull back into the hydrants of the inhabitants, was consumed by the people and spread disease throughout the entire community and endangered the lives and health of our people. After an agitation of some years a Commission was appointed by the authorities of this city to investigate the whole subject matter and report to the City Council some method by which the people of this great community could protect themselves. A Commission was made up of the most eminent engineers of this country and after a full investigation of all the different methods of sewage disposal they found that the only proper solution of the problem was cutting through a divide and cutting the channel deep enough and large enough so that sufficient water would be sent through the channel to dilute the sewage and make it unobjectionable to the people of the Illinois valley. The problem, of course, was one that was recommended by these eminent engineers because of the fact that, many years ago, as you are all, perhaps, aware, the Chicago River was the outlet of Lake Michigan to the Gulf of Mexico and it was simply a problem of restoring the outlet that nature had provided; hence they came to the conclusion that that was the only proper way, the proper solution and the only feasible solution of such a disposal. Other plans and systems that, perhaps, were applicable to other cities where the population was not so large and not growing so rapidly as we were and where the climatic conditions were more favorable—other methods might have answered the purpose; but here, as we were situated, no other system could have been adopted with satisfactory results.

The people of this city have permitted themselves to be taxed to an amount of over fifty million dollars, by direct taxation, for what? Why, for the purpose of self preservation, the first law of nature. The people are still taxing themselves so that the collateral channels may be cut, collateral to the main drainage channel. And I wish to call the attention of the Chairman, at this point, to the suggestion he made a few moments ago with reference to the Calumet. The Calumet channel when it is finally completed, will be a collateral channel to the sanitary district channel. It is essential and necessary for the purpose of draining that portion of the city of Chicago and the adjoining part of Indiana, bordering on the Calumet river and which is now sending its sewage into the Calumet, and then flowing into Lake Michigan, and, of course, it will pollute the waters of Lake Michigan and carry death with it if it is permitted to go to our people.

The channel that is proposed to be cut from the north branch, at Evanston, is also a collateral channel. As we grow in population in the city of Chicago proper, and as the suburban or adjacent cities grow, we must make provision for all of that sewage that will be discharged into these collateral channels to be carried through the main channel. Of course that will require water for dilution, and this water must be supplied from Lake Michigan. We have no other source of supply. When we consider that the experts who were called upon to furnish us information as to the requirements for perfect dilution of the sewage of the city of Chicago, who rendered their opinion at the time this whole matter was investigated, in 1885, 1886 and 1887, stated that it was essential and necessary that 20,000 cubic feet of water should be sent through the sanitary district canal for every 100,000 inhabitants; that that was accepted as the correct theory, and that only through that quantity of water could such sewage be made unobjectionable, so that the oxidation might take place, so that when it reached the towns of the Illinois valley it would be unoffensive, it was accepted by the citizens of Chicago, although we realized that it meant the expenditure of fifty or sixty million dollars in order to comply with that requirement; but in the interest of health, in the interest of the lives of our people, no sum of money is too great for us to expend in order to comply with the opinion of the experts who stated that this amount was necessary. Then, as I stated before, we complied with their wishes and embodied such a position in the law.

Now, as I understand the situation, it is proposed to limit the flow to 10,000 cubic feet per second. That would be sufficient until we have a population exceeding three million people. When we reach a population of three million people, growing as we are now growing, that period of time will soon be at hand. We are growing as a large manufacturing city, not only a large commercial center, but a large manufacturing center. You all know that every factory and every plant adds greatly to the sewage. We know that the volume of sewage will increase, perhaps faster and in greater proportion than the population. When we reach the three millions of people, if we are restricted by a treaty or by an Act of Congress, we would then be in the position of being unable to comply with the requirements which were considered necessary to send the water down for dilution.

If we increase in population to four million in ten or fifteen years—or to five million—I believe that you gentlemen realize that the quantity of water at 10,000 cubic feet per second would be wholly inadequate and we would have then no remedy. We would be restricted and limited and it would be disastrous to the health of not only the people of this city but of the Illinois and Mississippi valleys. As has already been stated by Mr. Haynie, a limitation might be in conflict with the decision of the Supreme Court of the United States in the case of Missouri vs. Sanitary District of the State of Illinois.

We are in earnest upon this subject. Those of us who have lived here for years and know what we may expect and know what we have endured in the past when the colour of the water of the Chicago river was as dark and black as it possibly could be, with a mass of silt in the bottom of the river; when the flood waters of the Desplaines came down and the surface water from the streets crowded the sewage back into Lake Michigan; when cases of typhoid fever increased at an enormous rate—those of us who have lived here and remember all that, those of us who know how fast this city is growing and how greatly the volume of sewage will increase from time to time—we fear that any limitation placed upon the flow of water from Lake Michigan through the sanitary district canal would be disastrous and a menace to the health and lives of the people of this community.

Gentlemen, I thank you for your attention.

Commissioner GIBBONS:—The desire of the Commission, of course, is to meet the wishes of the people of Chicago as far as possible, consistent with other interests, and I thought possibly it might shorten the discussion to suggest to these people that the difficulty the Commission is meeting with is this:—The gentleman who has just spoken has said that Chicago is more interested in the maintenance of the lake level than any other city. We agree with him that that is so. The Lake Carriers' Association, representing millions of capital, say to us, "We don't want you to do anything that is going to further lower the level of the great lakes. It is low now—too low now." So that we are met with this difficulty. The Commission appreciate the enormous possibilities of the city of Chicago, with its two million people. If you get to the four million mark, you will very likely want 20,000 cubic feet per second. Your experts tell us 10,000 cubic feet per second will lower Lake Erie 6 inches, and double that amount, 20,000 cubic feet per second, it will lower the level one foot. I only make these suggestions so that you can see the difficulties of the Commission. It would seem to me, that the Commission already have assented to the work which you have done and to the work which will be necessary to be done for some years, that 10,000 cubic feet will provide for you. It would seem to me that it is up to Chicago, in its own interests as well as in the interests of the country, now to see whether or not there is some other system that could supplement this system, that would make the maximum that you would require of water in this water. Other cities have found it, and although a Committee reported, as you say, back in 1885 and 1886, possibly you can supplement the present system. Your interests are our interests. We are all in the same boat in the matter of the preservation of the lake, and everybody concedes the necessity of preserving your health. You need not argue that to the Commission, because we Canadians as well as the Americans concede that Chicago ought to have what is absolutely necessary to preserve the health of its citizens. That has been the stand of the Canadians all the way through; but if consistent with that you can do something else to prevent injury to the great lakes system you ought to do it. It seems to me, now that you have your 10,000 cubic feet, you ought to be content with that at the present and see whether or not there is not some other system such as is used in other great cities that would enable you to do away with the necessity of increasing the water supply.

Mr. B. A. BECHART then further spoke as follows:

Gentlemen, it should be remembered by you that prior to the opening of the sanitary district canal in 1900 there was great agitation as to the effect it would have on the level of the lake. I remember distinctly there were predictions made that it would practically drain Lake Michigan dry. It was contended by the alarmists that the moment we opened the channel, that soon thereafter the navigation of the lakes would be impaired. Engineers who made the subject a study and were competent to pass upon the question made no such prediction; on the contrary they held that it would not affect the level very materially, if any at all. The channel was opened January 2nd, 1900. It has been in operation now nearly six years, and as a practical demonstration of the predictions made at that time, that it would have no practical effect on the lake level, we point to the fact that the lake level to-day is higher than it was at that time; that it has not lowered the lake, and it may be questioned seriously whether it would ever affect it materially. But even if it did there are other ways by which the level of the lakes may be maintained and raised, practicable ways without interfering with the health and the lives of the people of this country. The health and lives of the people of this country are superior to all other considerations, navigation or anything else.

Now, we claim, and I think it is susceptible of demonstration, that there are methods by which the lake level can be maintained and raised without interfering with any interest, much less that vast interest which is superior to all others. If, however, you say that is an expensive proposition, assuming that it is; assuming that Congress is required to expend five or ten million dollars in accomplishing that; here is a community that was willing to expend fifty million dollars for the preservation of its health.

Now, referring to the Chicago Board of Trade, and being directly interested in the commerce of this country, and more especially in the maintenance of the lakes, as I stated at the outset, we are, perhaps, more interested than any other association; we feel that if it were ever shown—and it has not yet been shown and it has not yet been demonstrated that it is a fact that the lake level has been affected, except to raise it, that can be remedied without attempting any other solution of the sewage disposal of a great community of two or three million people, which had been found impracticable and which, up to this time, has not been a success in any large community where the climate is such as it is here.

I, perhaps, have taken too much of your time, and I apologize for doing so.

Mr. ROBERT R. McCORMICK (President of the Chicago sanitary district:)—

Mr. Chairman and gentlemen, I had intended not saying anything until after the resolutions were all in—

General ERNST:— Then I think it would be well to keep to that practice.

Mr. McCORMICK: Do you wish us to confine ourselves to the question of lake levels from a commercial point of view, or only from the point of view of Chicago? The gentleman from the Canadian section has intimated, as I understood, that he wished us to bring out something upon the effect of the lake level. Is that correct?

Commissioner GIBBONS: That was my personal view.

General ERNST:— I do not think it is necessary to take up much time in discussion by the representatives of the commercial bodies, as to the effect on their business which may be of importance, but what the engineering effect will be is a matter we can get at in other ways. We will now hear from the Commercial Club of Chicago.

Address of Mr. FRANKLIN H. HEAD, Representing the Chicago Commercial Club.

Mr. FRANKLIN H. HEAD spoke as follows:

Gentlemen, I do not propose to take up your time for more than a few moments. The Commercial Club is a body of men small in numbers compared with those bodies represented by the last two or three speakers, but it is a body of men who have been undertaking to represent all of the great commercial and mercantile interests of Chicago. This Club has done a great many splendid things for the welfare of the city and it has never taken any position more important than this. I have put our views in the form of resolutions, which I will present to you, but I wish to speak on one or two points. One of the previous speakers has referred to the percentage of decrease of the death rate of the city of Chicago on account of the opening of the drainage canal. Perhaps you will understand the importance of that fact better by a concrete statement, which is this: That the number of people who were killed before the opening of the drainage canal by drinking impure water, every year, in the City of Chicago, was much greater than the number of people who were killed in the Spanish-American War on this hemisphere. That illustrates the importance of this matter to us.

There is one other point I will say a word about, which is this: You all understand, of course, that all the drainage of the country in the vicinity of Lake Michigan is into the lake, and the object of extending this system to take in the Calumet river and as far north as Evanston—which is really a part of Chicago, with a population of 40,000 to 50,000 people, and their sewage goes into the lake and also the sewage of the country around the Calumet river enters the lake; the Calumet river is an important part of the harbour of Chicago and its commercial facilities are nearly as important as the Chicago river's facilities, and in order to make those a success the system has got to be extensive enough to carry away all the sewage that is near enough the city of Chicago to pollute its water supply.

There is only one other point on which I wish to say a word. That is, that we appreciate very highly the importance of the work of this Commission and the great value it will be to us if the decision is such as we would like to have it. If this matter were a matter simply that we wanted more water, we could go to Congress and lay the matter before Congress, or go before the States Legislature, and when we showed that we could not have water to preserve the health of our people in sufficient volume to give us pure drinking water, without containing sewage and everything else, there would be no trouble whatever in our getting an additional supply; but you are a body of which it is expected that the result of your deliberations may be the execution of a treaty between the United States and England; and all of us who have ever looked into the diplomatic history of those two nations know that when a treaty is once made it is one of the most difficult things to have altered that anybody ever undertook to do. For that reason and others, may it please your Honors, we hope your decision will be broad and general and cover all the contingencies of the future.

General Ernst:—We will now hear from the Real Estate Board.

Mr. Frank G. Hoyne, representing the Chicago Real Estate Board and the River Improvement Association, spoke as follows:

Mr. Frank G. Hoyne:— Mr. Chairman and gentlemen, I come here as the representative of the Secretary and Chairman of our River Improvement Committee of the Real Estate Board to present to you the resolution passed by that body. The Real Estate Board is twenty-three years of age and represents to a large extent the property interests of this city. It is not necessary for me to go into argument, after you have listened, as you have, to Mr. Eckhart and Mr. Haynie, who have well covered the ground. Of course we, as property owners, are interested that this fifty million dollars which has been expended shall not have been expended to no purpose. If the flow of the rivers shall be regulated there is no telling what end it may reach or how adverse it may be to the health of our citizens, and so far we are interested.

It is not necessary for me to say anything more except to thank you and hand you the resolutions passed by our body. I thank you.

General ERNST :—We will now hear from the Merchants Club.

Mr. DAVID R. FORGAN :—I have presented their resolutions along with the others.

General ERNST :—the next is the Industrial Club.

ADDRESS of Mr. John G. Gilchrist, representing the Chicago Industrial Club.

Mr. Gilchrist addressed the Commission as follows :

Mr. Chairman, the Industrial Club is an organization of the younger business men of Chicago, ranging from twenty-five to fifty years of age. It is an exclusive organization, one of its requirements being that in order to be a member one shall be an executive officer of one of the larger industries, and the object of the Club is to serve Chicago, to serve its interests industrially, to serve the interests of its people. I think, while I have never seen a compilation of it, that the gentlemen connected with it as executive officers of the various industries represented, industries which would aggregate probably ten million dollars per member of capital—and I can think of three members who represent companies with an aggregate of over $150,000.000. And I don't say that with any idea of blowing the horn of the Industrial Club. but merely to impress you with the fact that the people behind these resolutions are people who have in their hands large commercial interests of the city of Chicago. Almost without exception the men in this Club, if they consulted purely their own commercial interests, would say, if the lake level would be affected, "Our interests are on the other side." They do not believe the level lake will be affected, but they believe, if the lake level should be affected, the humanitarian question is the great question, and as citizens of Chicago they realize it and they believe that the health of the people is paramount.

In illustrating my point I might cite the statement of a number of gentlemen of whom I took occasion to inquire very particularly as to the feeling of the people after the great disaster which San Francisco suffered six months ago. They said that during the first few days the commercial interests were not considered, but it was a question of the great humanitarian feeling for them, and they looked upon it as an evidence of the fact that the race was not degenerating.

The speaker lives in the southern section of the city. The water which supplies the homes of that section—and it is a large residence section—comes from the waterworks which were originally established by the old village of Hyde Park, which after having been enlarged, became a part of the city of Chicago. The Calumet river, at its mouth, flows in a northeasterly direction. The prevailing winds in this section. especially in summer, are southwest. The water flows in a direct line toward the crib. True, we may say the crib might be changed, but the crib is not in close to land ; it is out three or four miles. An inspection of the water reports, as appear in the daily papers. indicate that since the opening of the drainage canal the tendency towards impure water has been practically all from the Hyde Park crib, indicating that the influence on the Lake Michigan water supply and the Chicago water supply comes from the river, and the Calumet river's current must be changed ; it must be drained into the drainage canal. Within a very few years a very large portion of Chicago's population will be affected by impure water unless we get what we are now asking for.

Gentlemen, I thank you.

General ERNST :—The next on our list are Mayors of Illinois and valley towns.

(E, J. WARD of the city of Marseilles):—I want to say to the Commission that the people in the Illinois valley had to rise very early to get here and the Mayor of Joliet and the Mayor of La Salle could not get here. The Mayors of Marseilles and Ottawa, and others I believe, are here.

REMARKS by the Mayor of Marseilles, Ill.

Mr. H. B. McNabin, (Mayor of the city of Marseilles, Illinois) : Mr. Chairman, I represent the city of Marseilles as its Mayor. Our people are interested in this matter only from the standpoint of health. We do not object to the City of Chicago sending sewage down the river, provided they give us sufficient water to dilute the water, so that it will not affect the health of our people. We know that when the flow of water is reduced the offensive conditions of the rivers are increased very materially. All we ask is that in handing this matter sufficient attention be paid to the health of the people of the Illinois Valley. We know if a proper amount of water is used, it is not offensive.

General ERNST : Is the Mayor of the city of Ottawa present?

REMARKS by the Mayor of the city of Ottawa, Illinois, Mr. Charles E. Hock.

Mr. Hook then addressed the Commission as follows :

Mr. Chairman, I represent the city of Ottawa, located eighty-four miles from the City of Chicago. All we ask is that the flow of water guaranteed to us at the time the legislation was passed for the building of this drainage canal is complied with. The laws of the State of Illinois, as I understand it, guarantee to the people of the Illinois valley that they shall at all times have a flow of not less than 20,000 cubic feet per second per each one hundred thousand inhabitants of the sanitary district. We believe that, in order to protect the health and welfare of the citizens of this valley, through which the sewage of Chicago flows, we are entitled to have all that has been guaranteed us by the laws of the State of Illinois.

Now, for the Governments of the United States and Canada to come in and say, "You shall not have more than 10,000 cubic feet," we would regard as an outrage and as a violation of confidence.

We are glad to have Chicago's sewage pass before us if properly diluted and will stand for it, being ready at all times to further the interests of our metropolitan city. We believe that this Commission should give due attention to the interests of others than Chicago. We believe that the entire Illinois valley is entitled to your consideration, and we trust that you will give it to us.

General ERNST :—The Mayor of the city of Joliet. Is he here?

ADDRESSED by the representative of the Mayor of the city of Joliet, Ill.

Mr. NOBLE :—Mr. Chairman and gentlemen, the Mayor of the city of Joliet is not here. I was sent here hurriedly by him, and I wish to stand up with the representatives of the other cities of the valley in asking you people not to restrict the flow of water so as to endanger the health of the people of the Illinois valley.

As has been said here before, when the city of Chicago obtained the necessary legislation to construct this channel, they pledged to the people of the Illinois valley that they would give us enough water so that it would not mar the health of the hundreds of thousands of people living along the valley. Thus far they have kept their pledge, and we hope you will not take such action as will prevent their doing so in the future. For the present and for some years to come they probably will be able to supply all the water necessary to dilute the sewage of Chicago, but Chicago is a wonderful city, has made remarkable progress in the last twenty years, since the great fire. No one can tell what Chicago will be in the next twenty or twenty-five years. It certainly will be more than doubled in population in the next twenty-five years. If a treaty is enacted limiting the water supply they will be unable to give us the necessary water to dilute their sewage. It seems to me it will be unfair to put them in a position where they cannot carry out their contract with the hundreds of thousands of people living along the valley.

General ERNST:—The Mayor of the city of Morris. We will hear from him next.

REMARKS of Mr. George Redford, representing the Mayor of the City of Morris, Illinois.

Mr. REDFORD:—As representing the Mayor of the city of Morris, I will say that we have a city of about six thousand inhabitants, 62 miles from Chicago We are only interested in this matter so far as the health of the people of the city of Morris and those living in the ualley is concerned.

We are glad to see Chicago get an outlet for its sewage so long as it keeps it diluted enough to keep the valley in good, healthy condition.

We realize that Chicago is a great city. We like to see them progress and get out of their sewage difficulty, but at the same time we want to see them keep it diluted enough so as to keep the valley in a good state of health.

I thank you, gentlemen.

General ERNST:—Is the Governor of the State of Illinois present or represented?

Mr. ISHAM RANDOLPH:—I represent the Governor.

ADDRESS by Mr. ISHAM RANDOLPH.

Mr. Isham Randolph then addressed the Commission as follows:

Mr. Chairman and gentlemen, as representing the Governor of the State of Illinois, I have a statement to make, but I presume I ought to occupy the attitude of the small boy, which is to be seen and not heard. This morning I received a telephone message from the Governor of this state, Honorable Charles S. Deneen, stating that it had been his purpose to be present at this meeting and present the claims of the State of Illinois in this matter, together with their views bearing upon this subject. He said important matters prevented his being here and he asked me to state to this Board that he had delegated me to speak for him in behalf of the State of Illinois in this connection. I have had frequent conversations with him; I know what his attitude is; and therefore you will consider that I put aside my personality and that for the time being I have the high honor of speaking for the State of Illinois.

Gentlemen, my association with you has been such that I think you will acquit me of any intentional disrespect to your Board. I think that you will realize the confidence which I feel in your Board and in you as individuals. I have known the Chairman of your Board for many years and I have learned to have high regard for him, and I am sure he will acquit me of any intentional discourtesy or disrespect to this Board when he hears what I am about to say. The doctrine of States' rights, though perhaps conceived in madness, and has been submitted to the arbitrament of the sword and the decision has gone against it—but it was only against the madness and not against the doctrine—gives the

States certain rights, and the Governor of this State stands for all the rights of the State of Illinois.

We know that you come here fully authorized by an Act of Congress to inquire into the future of the waters of Lake Michigan. We know that you are performing the duties imposed upon you and we believe that you will do it faithfully and well. But, gentlemen, speaking for the Governor of this State, representing its sovereignity, we declare that it was a mistake on the part of the Government of the United States to permit any inquiry into the uses of waters wholly within the confines of the United States. The waters of Lake Michigan had never been mentioned in any treaty between Great Britain and the United States until the Treaty of 1871. That treaty defines the limits under which Great Britain and its subjects may use the waters of Lake Michigan. It is given equal rights with the citizens of the United States for a period of ten years, and is to continue thereunder until notice is given; but that treaty recognizes the rights of the States therein and limits the uses of the waters and the rights of the States. The States of Illinois, Indiana, Michigan and Wisconsin are the riparian owners of the waters of Lake Michigan, and they are as much a part of those States as the lands which border upon them. I do not propose, and it would be ridiculous for me to say, as a lawyer, what I propose to say, but I am born with that recognition of the individual right which has grown up to recognize the rights of the State and the rights of the Nation. We believe that, as a State, we have rights in Lake Michigan which are inherent and which even the Government of the United States cannot deprive us of. We believe that we have a right to the use of the waters of Lake Michigan. That lake is contributing to the general flow not less than 22 per cent of the volume of water from the lakes and certainly the States bordering upon the lakes have some rights to the use of that water.

Now, as to the functions of a state government, the state must protect its children. The state must protect its cities and its farming communities. The State must see that the rights of those cities and farming communities are not encroached upon. Therefore, when the State of Illinois passed the law which authorized the organization of the sanitary bistrict of the city of Chicago, it took full cognizance of the effect it would have upon the level of the lakes and the natural flow of the waters; it investigated, as best it could, the probable results from the turning of the Chicago river westward, and the best advice at that day was that there was needed 20,000 cubic feet of water per minute for each 100,000 inhabitants draining into the canal. The head of the Commission which made that report was in my office within the last week, and he said that during a number of years past he has been making sanitary investigations and that his conviction to day is as strong, if not stronger than when he made that report.

The lowering of the lakes, gentlemen, is an involved question. I do not think anything better has been written upon that subject than was written by a board of United States engineers of which our honored presiding officer was a member and whose signature is attached thereto. I will read from that report, from page 11:

(Mr. Randolph then read from the Report of the Mississippi River Commission, H. R. Document No. 263, as follows:

> "The effect upon the level of Lake Michigan of withdrawing 10,000 cubic feet per second for an indefinite period has been the subject of an elaborate investigation under the office of the lake survey in Detroit, and the conclusion reached is that the final effect will be to lower the level about 6 inches. (See Annual Report of Chief of Engineers for 1900, p. 5401, and for 1902, p. 2779 and p. 2825; also for 1904, p. 4120.) Oscillations of more than 6 inches in the level of the lake's surface are very common, often occurring hourly for many hours in succession, while oscillations of 2 or 3 feet within an hour are not uncommon. Still greater oscillations

within a year or series of years occur, all from natural causes. Moreover, during a severe winter, the discharge of St. Clair river is reduced by ice to less than one-third its normal discharge, the remaining two-thirds being stored up in Lakes Huron-Michigan and raising their levels; and the difference between the total discharge during a severe winter and the discharge during a mild winter will probably equal, or nearly equal, the discharge of the Chicago drainage canal for a year. A permanent average lowering of 6 inches in the lake's level, therefore, is not easily observed and will probably not be noticed by navigators. Nevertheless, the effect is real and important. Evidently there is a limit to the amount of water which can be taken from the southern end of Lake Michigan without compensating works at the outlet of Lake Huron. The Board does not condemn the present plan of taking 10,000 cubic feet per second, believing as it does that some amount will be needed to protect the lives and health of the people of a great city and of a populous valley, but it invites attention to the fact that if a much larger amount be taken it will be necessary to construct remedial works elsewhere, and that these are, or should be, of an international character. It is led to make this remark by the attitude of the Illinois Legislature and of the other principal advocates of this enterprise, which is that the 14-foot waterway is only a beginning, and that a much deeper channel ultimately should be constructed, which means that a much larger volume of water must be taken from Lake Michigan. It is the opinion of the Board that the sanitary reasons for the abstraction of water so far exceed and overshadow the commercial reasons that the amount should be strictly limited by the sanitary necessities of the case. It is impossible to fix a limit to the future growth of Chicago. In a future not remote, larger amounts of water may be needed for sanitary purposes, and channels deeper than 14 feet will then become practicable in the open alluvial portion of the Illinois River."

General ERNST:—Mr. Randolph, may I interrupt you? I wrote those sentences, and I am afraid you have laid undue stress on one of them—"and will probably not be noticed by navigators." when you undermine the foundations of a man's house, you may not notice it; but by and by it may tumble down and he will notice it then. I simply want to call your attention to the fact that that sentence may be construed to mean a good deal more than it does mean.

Mr. RANDOLPH :— But when you skim off the top of the lake the bottom will not drop out. Now, gentlemen, as to the necessities of the Calumet region. Yesterday you had an ocular demonstration of the conditions of the north and the south branches of the Chicago river and its surroundings. You must recognize that on the south the Calumet river is pouring its flood waters into Lake Michigan which, year after year, is becoming more and more polluted. One of the speakers has told you already that in the water reports the Hyde Park crib or Hyde Park intake is the most suspicious of them all, and that the water is now being polluted by the discharge from the Calumet river.

This is an involved situation. It is not under the control of the city of Chicago nor the State of Illinois, for the border lines of the two States pass through this region and 425 square miles of Indiana drains naturally into Illinois and Illinois cannot prevent the discharge of the pollutions arising in Indiana from entering into its own water courses. A good deal has been said about the effect of navigation. This navigation has been built up and fostered by the Government of the United States. It has become a source of pride to the Nation and of profit to corporations and to individuals. It has helped to build up these great cities. There is no paramount interest except that of health, and health you all admit, is the paramount interest. I heard a distinguished member of the Rivers and Harbors Commission, a Committee of our Congress, state in a speech one evening last week, that the total expenditures for the improvement of the lake system by the United States Government from 1856 to date was seventy million dollars, in fifty one years. Gentlemen, in fifteen years this district has expended fifty-one million dollars in the preservation of its health and reversing the flow of the Chicago river and it is counting upon expending eighteen million dollars more before that project is completed. If one city can expend that much money for the preservation of the health of its people, what amount of money should a Nation or a combination of Nations spend for the preservation of its commerce? It seems to me that the question of expenditure for lake navigation is not one that should enter seriously into this discussion.

One of our speakers has spoken of the use which Chicago makes of its by-products. The primary object of the drainage canal was the preservation of health. The secondary object is a waterway. Gentlemen, Chicago never would have embarked upon its waterway project, its fifty-million never would have been spent that boats may go down the Mississippi river, but it was spent for the preservation of the health of its inhabitants, and a condition has been created which it is the duty of the state and the nation to improve for the benefit of its people.

Gentlemen, I do not know what your report will be, and I mean no disrespect to you, and I hope you will not so construe it, when I say that if your report is against us we will not stop until we have gone to the court of last resort. We will not submit to any treaty which limits us as it is proposed to do. We have back of us the whole State of Illinois. I speak for the State. We have in sympathy with us all the States of the Middle West, and they carry influence into the National Councils which, I believe, will defeat any treaty which tends to limit us in what we believe are out rights.

Gentlemen, I have taken up too much of your time, and I thank you.

General Ernst:—Mr. Randolph you have been speaking as the Chief Engineer of the sanitary district and not for the Governor of the State of Illinois?

Mr. Randolph:—I have given some facts which I knew as Chief Engineer, but I have been speaking in behalf of the Governor.

General Ernst:—Do you expect to address us as an engineer?

Mr. Randolph:—No, sir.

General Ernst:—On the 22nd of June last, at the hearing at Buffalo, the Commission asked for a copy of your Report on which the new plans were based for the Calumet region. We did not get it, and I wrote you on the 14th of July reminding you of that, and again on the 30th of July, and have had no answer to those letters.

Mr. Randolph:—There is no printed report other than I sent you.

General Ernst:—We understand there is no report covering those studies.

Mr. Randolph:—No, there is no report covering those studies. I think probably the best thing upon that subject is the discussion which appears in the proceedings of the Board of Trustees for, I think, June 19th, 1901.

General Ernst:—What is the estimated cost of that plan.?

Mr. Randolph:—Twelve million dollars.

General Ernst:—Does that include anything for diverting the upper Calumet?

Mr. Randloph:—That included $200,000 for reversing the flow of the upper Calumet into the lake, into Lake county, Indiana.

General Ernst:—Where is that diversion to be placed?

Mr. Randolph:—That diversion will be into the State of Indiana and Lake County, and, of course, cannot be done without permission of the State of Indiana, which has not been procured.

General Ernst:—That would include a new channel into Lake Michigan?

Mr. Randolph:—The Little Calumet, you will remember, at one point, runs very close to the lake and it is proposed to cut across into the lake, making that stream so that it will take very little to divert the flood waters of the river into the lake. The waters at present are uncontaminated by manufactories, or anything of that sort. It is a barren region.

General Ernst:—An essential part of your plan is to divert the Calumet, by a separate channel, into Lake Michigan?

Mr. Randolph:—Yes, sir.

General Ernst:—How much would the flow be?

Mr. Randolph:—The flow from the Calumet is very slight, indeed, but in flood times it is very large, indeed, and it is at flood times that we want to care for it.

General Ernst:—In one of your hearings, before one of the Committees, you stated that the flood water at Riverdale was 750,000 feet per minute, amounting to 12,500 cubic feet per second.

Mr. Randolph:—Yes, sir.

General Ernst:—Who made those measurements?

Mr. Randolph:—I did not make them and I have forgotten who did make them, but I am satisfied that they are reliable from the way in which they came.

General Ernst:—12,500 cubic feet is disposed of?

Mr. Randolph:—Yes, sir.

General Ernst:—You have got to have a channel somewhere to carry that amount of water?

Mr. Randolph:—Yes, sir. The flood waters cannot be brought through the Calumet channel that is proposed to be built. It could not be taken care of. We propose to have a lock there and at no time to take in more than 4,000 cubic feet per second through that channel.

General Ernst:—In case of flood waters, the waters would have to come out through the Calumet river or somewhere.

Mr. Randolph:—Somewhere, yes, sir, but under those conditions they would not be carried out, if it were built as they now build the locks. You are familiar with the conditions of the Calumet river. You know that for long periods the water is practically stagnant; that there is no current there, and the sewage lays in the stream and rots until it is swept out by the flood into the lake.

General Ernst:—As I understand it a part of the project is a diversion into the State of Indiana, for which you have no authority, and for which you have been allowed $200,000.

Mr. RANDOLPH:—Yes, sir.

Commissioner CLINTON:—You made the statement that Illinois would not submit to a treaty which would limit the amount of water that might be passed through this canal. I would like to ask why that statement was made. The reason I ask is because this Commission has in view no such treaty and we have heard of no such proposed treaty.

Mr. RANDOLPH:—If I remember rightly the preliminary report of the American section recommended that we be limited by treaty to 10,000 cubic feet per minute.

Commissioner CLINTON:—The preliminary report of the American Section did make that statement, and it is assumed that eventually the Niagara Falls situation will have to be regulated by a treaty, but it was not presumed by the Commission that a treaty would be made which would specifically limit Chicago to 10,000 cubic feet. Indeed, so far as the Commission is concerned, the idea of a general treaty, if one were entertained—I do not mean really to speak for the Commission, but to express my own ideas—a general treaty could not cover specifically each question arising on the lakes.

Mr. RANDOLPH :—The general treaty would contain no names.

Commissioner CLINTON :—It could not take care of all the conditions that arise, for instance in Chicago. I do not know but that this Commission had in view the idea of limiting Chicago to a specific amount of water.

Mr. RANDOLPH :—That is the impression I had.

Commissioner CLINTON :—I think I can say that the Commission has no such idea as that.

General ERNST :—Mr. Randolph, this system of sewage disposal which it is now proposed to extend to the Calumet river, is based entirely on the report of the Commission of 1887. No new studies of any other method of disposing of the sewage of the Calumet region has been made, has it?

Mr. RANDOLPH :—No, sir.

ADDRESSED by Mr. Robert R. McCormick, President of the Chicago Sanitary district.

Mr. McCormick addressed the Commission as follows :—

Mr. Chairman and gentlemen, in behalf of the sanitary district of Chicago and of the city, which is a part of the sanitary district, I welcome you to Chicago, and I congratulate you upon the broad ideas that led you to come here to study our situation. I wish to express my regret that circumstances over which we had no control, and over which I am sure you had no control, made it necessary to report to Congress before we could present our case. It was also necessary for me, in my official capacity, to go before Congress and work against your report. I make that statement because I hope there is no feeling harboured by your Commission that we were playing around you and not paying you all the respect which we are glad to say is your due. The point of view of the people on this side of the country, the chief desire of the treaty of Great Britain is to prevent the spoliation of Niagara Falls. The public Press, not only in New York and Chicago, but all over the country, has drawn the attention of the people to the fact that a number of corporations are taking the opportunity of using the water power of Niagara Falls for their private gain and profit.

with the loss of that great piece of scenery. It came as a surprise and shock to the Board of Trustees, of which I am President, to find that we were brought in on the question of Niagara Falls. It never occurred to us that our flow would be considered a part of the flow that it was considered, and for these reasons, gentlemen, there was no object which would lead the city of Chicago, through its Sanitary District Board, to take any more water from lake Michigan than it absolutely has to take. It is not a profitable investment. Some persons would like to get the right to locate a plant near Niagara and use power worth millions of dollars, which would damage the country many millions of dollars ; there are such men, seeking to increase their fortune by getting water from the Niagara river and taking it from the falls ; but with us there is no such object. I am glad you went down the canal yesterday and saw the enormous cost of the work. You must realize the enormous cost of it. Do you believe, gentlemen, for the purpose of widening the Chicago river about 30 feet the district spent one million and a half dollars to get the right of way, to add a slight amount in the flow to comply with the law? For that reason, gentlemen, we will never take any water from Niagara Falls. We further found, and our representatives in the House have concurred with us, that the use for which we are taking the water was quite different from the use for which the water was taken at Niagara, and I believe the Congress of the United States would say, if asked : ''Gentlemen, we are going to recommend that not more than 60,000 cubic feet per second be taken away from the falls." There is a certain number of power companies on the Canadian side and a certain number of power companies on the American side, organized for profit. The Canadian Government, in its wisdom and proper functions, is making the power companies on the Canadian side pay a just share on their profits. The Americans have shown no such foresight or statesmanship.

The sanitary district of Chicago and the municipal corporation have taxed themselves over fifty million dollars, and are taxing themselves, not with the idea of getting any profit out of it, but because the sanitary district does not know, in its legal and constitutional capacity, any other way of disposing of its sewage. They claim they need 60,000 cubic feet per second and the power companies say they need it. I believe the Congress of the United States would say, "Give the power companies nothing and give the people all they need for the preservation of their health."

It is not necessary for me to suggest what may be needed in Canada in the future. I do not know but that some time there will develop on the other side of the great lakes a city similar to Chicago, equal in size, which will need, perhaps some system of drainage. If that should happen in my lifetime or in the lifetime of the gentlemen present, they would be the first to go to our National Government and urge that they be given all the aid they need. So much for Niagara Falls.

Now a word, which, if it came to me as an individual, I would not ask you to listen to, but as it comes from the compiled knowledge and study of many men, and is presented by me purely in my official capacity, I will put it before you. Taking the great lakes from a commercial point of view, what happens? We have a condition unknown anywhere in the world, We have a water-shed a navigable waterway if you will, such as was never conceived of by the people who framed the common law. We have a number of great reservoirs collecting millions upon millions of gallons of water. This water can be used for commerce, for the benefit of the two great countries which lie side by side on this continent. The question arises, "How can it best be used", and the answer from every source must be "We do not yet know." We know the few locks connecting the lakes have developed enormous trade. We know that the foresightedness of our Canadian neighbors has been of great public benefit to Canada and the United States, and we congratulate them upon their public work. To-day, all over the country, and chiefly in this neighbourhood, the talk of waterways is coming forward. It is stimulated particularly because a great canal has been built near Chicago. It has been stimulated because Panama canal is being built. It has been stimulated because the people of the United States have had untold trouble with their railroads. I am not here to talk politics or anything else but drainage, but I have to refer to these things to present the matter before you as I see it.

The cry is up all over the country, "How are we to regulate traffic rates," and opinion varies from no regulation to government ownership and having a competing system of waterways. I do not pretend to hold any opinion upon the feasibility of making many deep waterways throughout this country. Eminent men and statesmen have opinions, and they are voicing them. Millions of cubic feet of water in the great lakes can be used as a reservoir for many of the waters. There is talk of a waterway from Chicago eventually to New Orleans. There is talk of a waterway from one of the great lakes to Pittsburg. We are looking forward to the time when our Canadian neighbours or our eastern neighbors will build a deep waterway from the great lakes to the ocean. Let us be very careful how we take any action now which may bind our hands in the future.

A treaty is the most sacred instrument that can be entered into, a treaty between the two great English people, people who are so alive as we are. With us a treaty is not something to be broken as soon as we begin to be irritated by it. Why pass a general principle and treaty as I read in your report, gentlemen, that no water should be diverted from the St. Lawrence channel? It does not necessarilly follow, if you take some water from it that there will be no water there. It does not follow that if we have a channel in Illinois you will not have a channel in Ontario.

Let the great lakes be kept open for future negotiations. If—and I do not believe it for a moment—if the flow into the Drainage Canal should lower the lakes, works can be put between each lake to dam the water to a certain height and a channel can be made there to give you the proper waterway. To come down to the fundamental fact of our very existence, the Governments of the United States and the Canadian Section are complicated in the extreme. The United States Government and the State Government have certain powers, which, in turn, they may delegate to municipalities like our own. The State Government has said that for every one thousand hundred inhabitants we must flow 100,000 cubic feet of water down the river. Your Commission of the House of Parliament and Congress, at present acting together, cannot change that law. Should you be able and should you desire to limit the water going into the sanitary district now, the time would come when you could not do so. Our friends down the Illinois valley have complained of trouble which we have endeavoured to remedy and they have put in a proper protest. The State of Missouri filed an injunction suit which you lawyers will remember, over which the Supreme Court of the United States took original jurisdiction, seeking to prevent our flowing water through the Illinois river into the Mississippi. The Supreme Court held that there was no cause of action shown, and that if a cause of action were shown, the Court might take some action.

We have spent over fifty million dollars now, and according to the best engineering and scientific advice we can get we must spend twelve millions more to build the two collateral channels, and then what? The possibility that the whole thing may be wiped out, the canal closed, and the great, growing prospects of the West left floating in the air, without a thing to grasp or light on. The people of the West are very much in earnest upon this matter They are also very much in earnest in desiring to have a treaty ratified between Great Britain and the United States covering all the questions on the great lakes. They are very much in earnest in wishing to have Niagara Falls preserved, and they are very much in earnest in their hope that you will not make a recommendation which will cause the failure of any trade whatever.

General Ernst:—Is the Attorney for the sanitary district present?

Mr. E. C. Lindley (Attorney for Chicago sanitary district):—Yes, I am here representing the Chicago sanitary district.

ADDRESS BY MR. E. C. LINDLEY, ATTORNEY FOR THE CHICAGO SANITARY DISTRICT.

Mr. C. E. Lindley, Attorney for the sanitary district of Chicago, thereupon addressed the Commission as follows:—

Mr. Lindley:—As Attorney for the Sanitary District I was requested by the Board to make a few suggestions to the Commission, but I will frankly tell you at the beginning that I will not make any legal argument upon this occasion.

I do want to answer what seems to me to be a wrong impression which some of the Commission have relative to the Calumet channel. As I have gathered it, this Commission seems to think that the sewage in the Calumet district should be dealt with differently from that of other portions of this district.

The sanitary district has a frontage on the lake of something like thirty miles. In that frontage on the lake there are opening into the lake the Calumet and the Chicago rivers. There is no difference between the legal status of the Calumet district and this territory right here so far as the sanitary district is concerned. When it was organized as a sanitary district, it was voted that all the territory within it was so situated that it could be drained by a common outlet. The people of that district have been taxed to build this channel, and the people north of us have been taxed and will be taxed to complete this channel just the same as the people here. It is a part of their system just as it is a part of the system of the central portion of the city. South Chicago is just as much a part of the city of Chicago as any of the little stations lying along the lake front. There is no difference so far as the sewage is concerned between the 39th Street sewer, leading from Lake Michigan and emptying into our main channel, and that of the main channel.

At 39th Street the city of Chicago has built an intercepting sewer. When it is completed the waters of Lake Michigan will flow through that sewer into the main channel. It is for the purpose of intercepting a sewer of a certain portion of the city to keep it out of the lake, and the object of the Calumet channel, so far as the sewage proposition is concerned, is identically the same—that it is going to take the sewage of the district known as the Calumet district and send it down into our main channel. It is nothing but a collateral channel to the main channel of the sanitary district, and the purposes for which it is being built and the waters which will flow into it are the same as the purposes and the same as the waters for the main channel, and the water is for the same purpose.

When all of the waters from all our collateral channels shall be collected so as to flow into the main channel, as they will, the flow will then be only such as is required by law for dilution. If we did not build the sag channel to carry off the sewage of that district we would either have to extend the intercepting sewer, that reaches from 39th Street, so as to go into that territory and bring the water this way and take it out through there, but the volume of water required for dilution would be no greater one way than the other.

Therefore, the purpose of all the channels, primarily is the purpose of sewage, and all the water needed for all the channels is for the purpose of proper dilution. I do feel, however, that I should suggest to this commission one or two points, without arguing them.

I have read, with considerable interest, the briefs that have been filed by this Commission, the briefs filed by the Minneapolis and Minnesota Power Company; I have read the various briefs filed by the Committee on Rivers and Harbours, when the matter was there for hearing, and this Commission is familiar with all the propositions of law which naturally arise in this case.

I will say that, between the proposition of law which have come up in this connection and those which our brothers down the valley have raised, that we seem to be between the coming and the going of the waters. There were some people down the valley at some time who objected to all the water coming down there and there were some people up here who objected to letting any of it go down there. So far as the State of Illinois is concerned and the people of that State, we have established our rights relative to the waters going out. We do not want to become involved to too great an extent with the people on the other side. We submit to the American members of this Commission that this is a question which should not be incorporated into a treaty, either by specific limitation or by general statement, or by putting in the power of a permanent Commission the authority to determine how much the flow should be. As it now stands when anyone wants to do anything which affects the waters of the Chicago river, he has got to consult the municipality of the city of Chicago, the municipality of the sanitary district, the State of Illinois, and the Federal Government; and if you are going to add to it another body, and an international body, you can see the great troubles that will come to us whenever we may need some change made.

We submit as a proposition that there has been evidence here this morning that if the time ever does come when this district, by reason of its diversion of waters, is going to affect the commercial interests of the great lakes, that you can leave it with the American Government and the people who are interested in the commerce on this side to see that we are stopped; that it is not needed that there shall be an international commission to which that question must be referred. If the time shall come when the American commerce, on the American lakes, and the trade represented here to-day by five thousand merchants, by the one thousand members of the Board of Trade, by the nine hundred members of the Manufacturers Association, when their interest, which is primarily the interest of commerce, after all, is deleteriously affected by our acts, you can leave it to them to put a stop to it, without asking the aid or assistance of a foreign country.

It has been suggested by the Governor, through our Chief Engineer, that there are certain rights of the State to be observed. I take it that if this Commission and ourselves were to discuss the legal status, that we will not differ. I take it that there is no dispute but that the territory—the bed of Lake Michigan lying west of the center line of the lake and south of the northern line of Illinois, belongs to the State of Illinois. It has been so decided by the Supreme Court of the United States. It has likewise been decided that the bed of the lake belongs to them; and while the waters belong to them for public use, it has likewise been decided by the courts that the peoples living upon rivers and lakes have the right to use such waters as may be needed for sanitary and domestic purposes, and that that right is paramount to the right of navigation, notwithstanding, I believe, some suggestions in some of the briefs, that it was not.

If I understand the law correctly upon that proposition it is this: That the right for domestic purposes, which must include sanitation, the right that has accrued to every person to have riparian ownership from time immemorial, that that right has been held to be paramount to the right of navigation, upon the theory that it could not interfere with navigation, for the reason that the amount of water so used was, in the presumption of the law, so small as compared with the amount required for navigation that it would never interfere therewith. And that comes up to this question: You are purposing to limit, or recommend the limitation of the amount of the flow or diversion from the lake for this purpose. In other words, suppose you did limit it to 10,000 or 14,000 cubic feet a second; if you did put a limit, you have laid upon this District a legislative injunction, saying "You can go so far but no farther."

I do not need to suggest to this Commission any principles concerning injunctions generally; that when a lawyer goes into court, either in Canada or in the United States or England, that he must make a showing before he can get a prohibitive writ. He would have to show clearly that he was going to be injured in some respect if the writ did not issue, and I submit to this Commission, for its consideration as a legal proposition, that it has not been established so clearly and so definitely that any interests will be injured unless we are limited so as to justify the legislative injunction against the flowing of more than a certain amount of water from Lake Michigan.

One other point: In 1822 and 1827 the Congress of the United States passed certain acts granting to the State of Illinois certain lands extending from here to the City of Ottawa for the construction of a channel to connect Lake Michigan with the navigable waters of the Illinois. Pursuant with that grant the State of Illinois did construct a channel, known as the Illinois and Michigan canal, leading from the Chicago river, not more than, I assume, half a mile from where our present channel connects the headwaters of the Illinois river. The waters of Lake Michigan, since that time, upwards of eighty years, have flowed from Lake Michigan into Illinois river, for the purpose of navigation and carrying away the sewage of the City of Chicago. It was in pursuance to that grant and in the belief that they possessed the right to build and maintain and forever keep a waterway sufficient for the purposes, as the law was worded, that they undertook that work.

They have spent, in the construction of that canal, and in the construction of the canal which the sanitary district has constructed, upwards of eighty million dollars. That construction has been going on for eighty years. It has been open and notorious. It has been the subject of international agreement with Canada. Canada has known it; England has known it; the United States Government has known it, and we have known it for eighty years. We have supposed from the beginning that we had the right guaranteed us from the beginning, to have a waterway which would keep up with the permanent interests of the country. It would have been foolhardy for us to have started out upon such a system if we had been notified from the beginning that at a certain period we could not make that work commensurate with the needs of commerce. And we submit, as a suggestion along this line that, with our ownership in the bed of the lake, with our ownership in the water, with the fact that Lake Michigan lies wholly within United States territory, that in view of the fact that it has not been clearly shown that this work will affect any other interest detrimentally, substantially, in view of the fact that we have proceeded along this line so long, it is not now becoming on the part of either of the Governments that they should seek to stop us in the midst of that work, which is now only half completed, and let the great expense that we have gone to go to waste.

Gentlemen, there are several other propositions that I would like to discuss, but I have already transgressed upon your patience, and I thank you.

General Ernst:—Is there anyone here representing the Calumet river basin?

Mr. Stevens Foster:—I represent the Calumet river basin.

General Ernst:—We will hear from you.

ADDRESS BY MR. STEPHEN FOSTER, REPRESENTING THE CALUMET RIVER BASIN.

Mr. Stephen Foster then addressed the Commission as follows:—

Mr. Chairman, I would like to say a few words, not as an attorney for the sanitary district, but as a Calumet man, on the Calumet district. I was a Calumet man long before I became attorney for the sanitary district, and I expect to continue to be a Calumet man long after I cease to be an attorney.

When I went down the main channel with you gentlemen yesterday, it did not occur to me that it was at all probable that I should appear before you today, but in talking to you yesterday and listening to the discussion this morning, it seems to me certain pertinent facts in connection with the Calumet territory should be presented to you. Some of the American Members of the Commission are doubtless familiar with them, but I think other members are not.

I brought over this morning with me a map showing the sanitary district and the confines of the Calumet river. It is not distinctly marked here, but the confine of the original sanitary district, as organized in 1889 and existing up to 1903, extended on the north to this point and on the south to this point, (Indicating upon plan) including the major portion of the city of Chicago, but not all of it. On the north we have the city of Evanston, the towns of Winnetka and others, running up to Lake Forest, the drainage and sewage from which emptied into Lake Michigan and polluted the water supply of these several municipalities and of the city of Chicago. On the south we had the Calumet territory, so called, taking its name, I believe, from the old town of Calumet, of which I am a resident and of the Calumet river, which flows through its centre. That territory likewise was emptying its sewage into the Calumet river, directly into Lake Michigan, and polluting the waters of Lake Michigan, and so the surrounding suburbs of Chicago and the water supply of the city of Chicago.

At this point you will see the Hyde Park crib, indicated upon that map. We call that the 68th Street pumping station, or at least the pumping station is on the shore, taking the waters from the Hyde Park crib. That is located a distance of about three miles from the mouth of the Calumet river. From that pumping station the water supply of Chicago is drawn, the supply for all the people of Chicago south of 14th street. That is not the exclusive source of supply but the mains of the city of Chicago are so connected that water from that pumping station finds its way into the mains as far north as 14th Street. I have not the exact figures here as to the population of the city of Chicago at any time south of 14th Street. South of 39th Street, a point two miles south of 14th Street, the population, in 1900, was 415,000 people, 67,000 people more than in the entire city of Buffalo, of which one of your members is a citizen. I only speak of that as showing the magnitude of the interests involved here and the large number of people who draw their water supply from that source.

Further than that, that is the portion, of Chicago that is growing fastest, and as you get farther south, toward the Calumet district, you find the ratio of increase greater. I am not talking about estimates; I am talking about federal figures, and the last federal census we have was in 1900. The increase in population in the entire city, from 1890 to 1900, was from 1,000,000 to 1,593,000, or an increase of 54 per cent. South of 39th street the population in 1890 was only 182,000, while in 1900 it was 416,000, an increase of 127 per cent. Chicago, south of 63rd Street and 55th Street, there being a jog in the boundaries of our wards coming over here, (indicating upon plan) the population of that portion of Chicago in 1890 was only 75,000 while in 1900 it was 199,000, an increase of 165 per cent. In my own ward, the old 34th, the largest ward, territorially, in the the city of Chicago, our increase was from 30,000 to 91,000, or an increase of 200 per cent. Nearly those same figures represent the growth in the ward lying east of me, South Chicago. The question you gentlemen seem to desire to consider mainly is this Calumet project, and that has interested me many years. That territory is growing, as the figures show, and the city authorities, recognizing that growth, are providing for it as best they can. There are new and large land tunnels being constructed today, costing millions of dollars and extending out to that 68th Street crib for the purpose of supplying the people of that district with the waters drawn from Lake Michigan. For a long time we had a great deal of difficulty getting any sewers in that district. Some of us, who were foresighted enough in the early days got the sewers in before the city of Chicago awoke to the fact of the importance of the question that is now confronting us and you—pure water for Chicago. We got our sewers built, but in other districts no sewers were constructed and the city authorities took the position that no sewers should be constructed in the Calumet territory, emptying into the Calumet river, because by so doing they knew that the water supply of Chicago was polluted and the lives of its citizens endangered.

What was the result? In the vast Calumet territory to-day there are enterprises on every hand; at South Chicago, near the mouth of the river, the Illinois Steel Company, represented by Mr. Haynie to-day, employing eight thousand or nine thousand men. If you go up the Calumet river, as far as 122nd street, four miles, I think, from the mouth of the river, all along at intervals you will find great enterprises. Over on the other side of Lake Calumet is the great Pullman Company, with eight thousand or nine thousand employees; at West Pullman, further west, the International Harvester Company has one of its great plants, as it has a second one on the Calumet river. These great plants are magnets for men and they go there. Where do they live? They live in streets where there are open sewers, in many instances, in districts out there that are attractive. I am fortunate in living where we have sewer connections, but there are many good citizens of Chicago who, when they step out from their homes, have to cross an open ditch filled with slime and have to hold their noses and they don't know whether they will have to get off in such a place as we did at Bubbly Creek last night.

To take care of that situation, since the annexation of the sanitary district to the city of Chicago, in 1893, the city of Chicago has given great attention to the building of this great sewer. When it is completed it will drain seventeen or eighteen miles of territory.

I wish it had been possible for you gentlemen to have visited that river. It is a noble stream. And I wish you could have seen the territory out there. The physical conditions of Chicago impressed you yesterday. I understood you to comment on its unfavorable condition; this great, flat prairie--why should anybody have built a city here? It was built here because of the Chicago river, because of the navigation interests, because of the commerce that came to this great harbour. But at the Calumet we have a harbour which, I am sure, the engineer will back me up in saying is superior to the Chicago Harbour. It has been pronounced by the United States Engineers, from the earliest times, and conspicuously by Major Marshall, as the greatest artificial harbour on the great lakes.

That situation is drawing people there, just as such a situation drew people here. We are going to have a great city south of us, part of Chicago, as vitally interested and as patriotic as any other part, but still, in a sense, a distinct community, having interests which have been only partially represented here today.

I will call your attention to the winding character of the course of the Calumet river. The so-called Grand Calumet rises in Indiana and flows, or rather exists—because it does not flow; it is an absolutely stagnant body of water—east, and comes to the forks at this point, and thence north into Lake Michigan (Indicating upon plan.) The so-called Little Calumet, which is really a great deal larger stream than the Grand Calumet, so far as the water-shed is concerned and so far as the amount of water that flows through it is concerned, rises here in Indiana and comes east (Indicating upon plan) and then makes a sharp bend east, adjoining the Grand Calumet at the forks and flowing north into Lake Michigan.

I am not an engineer and as to the possibilities of many of these plans that have been worked out, I shall not address you. The proposed cut-off alluded to by General Ernst is marked in red here, to be constructed, I understand, to take care of the water-shed in Indiana, and a dam is indicated on the map here for the purpose of diverting the water back that way. (Indicating upon the plan.) All of that water it is intended shall go back into Lake Michigan in that way, but the waters that it is proposed to take care of by this Calumet channel are those from this point here and from South Chicago there. (Indicating upon the plan.) This map is on a small scale. Each of those little squares is a square mile. (Indicating as before.) The distance from the mouth of the Calumet river to Center Avenue, the beginning of the proposed Calumet channel, is about twelve or thirteen miles. It is not near that cross country. Some engineers of the past, when they spoke about waterways, indicated a cut-off in Lake Michigan. We are not talking about that. Around the river it is about thirteen miles.

The Calumet river has abrupt turns. It winds around the marshes. It is a great duck country, in many portions. It has low, swampy land, and some of the plants I have alluded to are located on land where they must have put their foundations into the water because the land was so low.

The river at its mouth is one of the important, navigable waterways of the United States. It has been so recognized. Some of our friends in this city have been a little jealous of us because the United States Government has been so liberal in its provisions for dredging the Calumet river. As I remember the total appropriations have amounted to four or five million dollars for the Calumet river and Calumet harbour. It is a magnificent harbour. The authorities have given that a width of 200 feet by at least 20 feet deep at its mouth and extending, according to the present project, to 122nd street. I am not positive that the full depth goes there. Therefore we have a stream several miles long, 200 feet wide by 20 feet deep, with sewers emptying into it every few blocks. That is the South Chicago situation.

South Chicago, of itself, has some 50,000 population, resident there, and a good many more that would reside there if the sanitary conditions were such as to permit them. Hundreds of men there get on the street cars and the steam railroads, coming up into the city, rather than live in a place where they can't have sewers.

Around through here there is very little building that has been done; (indicating upon plan); it is largely marshy. Over here you begin to strike the towns. (Indicating.) At Indiana Avenue there is a large sewer that drains Pullman. There is a cluster of towns in there with about 40,000 people. (Indicating upon plan.) In less than a mile further west you come to the great Wentworth Avenue sewer, 10½ feet in diameter, next to the largest sewer in the city of Chicago, serving a large territority, going north to 91st street, I think. A little further west is the Halstead street sewer, 4½ feet in diameter; at Ashland Avenue a three-foot sewer. Over at Blue Island, a separate municipality, claiming 10,000 people, the sewage goes into the Calumet river. Coming up here, around the bend to Harvey, there are 4,000 more people, whose sewage empties into the Calumet river. There is sewage all along in that river. A big body of water, near the mouth, the sewage empties into the lake and pollutes the waters of the lake. The Calumet is a winding channel, of varying depth. Major Marshall said, in 1888, the Calumet river had an average depth of eight feet. He had elaborate surveys made, and I suppose we can rely on his figures, but there are places that are shallow and places that are deep. There are pools in places. I am not an engineer, as I have stated, and as you very likely have realised from what I have said, but it seems to me a physical impossibility to suck out of a body of water the size of the Calumet river the sewage and carry it off without a large project out there.

I am not here to discuss the various forms of the disposal of sewage. Possibly Chicago has made a great mistake in having adopted that method; possibly it ought to have adopted something different. I don't know about that. But I do know the great crying need of that district, a district next to this Sanitary district, with one hundred square miles of territory, with a population of 150,000 people, with industries representing many millions of invested capital, employing, I have no doubt, upwards of thirty thousand men and a nucleus for a population two or three or four times what we now have—the crying need of that territory is drainage.

There are districts in that territory that are under water in the spring. It used to be a joke appearing in the papers that out at Burnside some three or four people would get into the water and were drowned going to school—school children. I have seen all that territory under water. We don't want anything done that is going to prevent getting drainage out there. We were against that proposition with a municipality of much less importance and dignity, I confess, than the ones represented here; but we do not want to be confronted with an international treaty that is going to prevent building the Calumet Channel. The Calumet Channel as proposed by the engineers—and I think they are unanimous in their opinion, as to the necessity of channels of that size—will have a flow of 22 feet of water. It seems to me that is the minimum of what is necessary. If we have just a little stream coming out of the top of a big body of water, with sewage trickling into that big body for 12 or 13 miles, what is going to be the result? There is not going to be any scouring; the sewage will settle at the bottom and collect in pools and when the spring freshets come on, the sewage will be taken out into the lake and deposited near the crib and pollute our water supply.

It is admitted, I understand, that we cannot take care of all the spring floods, but that is merely a temporary matter. Suppose, for the period of a month in the spring—and that is as long as our floods last—this channel was to be partly closed, if the channel was pure and had not collected in it a great amount of sediment, the sewage that would get down to the lake would be of very little importance and would be swept into the river and through the channel when the Calumet was opened again; but if you attempt to take a small stream out of that great body of water or attempt to pump it out, it seems to me it is a self evident proposition that sewers emptying thirteen miles away, in South Chicago, into a stream that crossed a section 200 by 20, that that sewage would sink to the bottom, would collect there and there would be no power to take it out. The fall from South Chicago to Blue Island is only about one foot and 22 feet of water in that channel will only give the natural depth of water to take care of that large mass in the river and to keep the bottom of the channel scoured.

It has been suggested that we could create, by pumping or by some other device, a small stream, and that we could get a more rapid current, and so not have the necessity of so large a channel. That, however, is a consideration that would not appeal to you, anyhow, because what you want to consider is the question of the amount of water. You do not care whether it comes fast or slow, but I repeat, as to that, it is an utter impossibility, it would seem, because of the navigation interests involved.

The commerce of the Calumet river has increased in the last ten years at a ratio of about 500 per cent. It is a great harbour. The United States Government to-day exercises jurisdiction over it and would never permit a current in it that would endanger the navigation interests.

What I have said has been on the part of the Calumet territory. I know that I voice the feelings of every resident of that district. I expected to have some better views here, inasmuch as you were not able to see the Calumet river, but I am sure this plan will convince you of the truth of my statement, together with this photograph, that the river is 250 feet wide, near the point where channel begins. Substantially it is 200 feet wide and as to its depth we have Major Marshall for our authority, that it is eight feet.

General ERNST: We will now hear from the Mayor of LaSalle.

REMARKS BY MR. WALTER FANNECK, MAYOR OF LASALLE, ILLINOIS.

Mr Walter Panneck then spoke as follows:—

I know very little of the difficulties of Chicago, the difficulties you gentlemen have had to contend with, but I come here representing the people some 100 miles west of Chicago. When, some years ago, the drainage proposition was submitted to the people of the Illinois valley, the people of Peru, Spring Valley, Morris, Marseilles, Peoria, and all throughout that district sent representatives to Springfield to fight the proposed law. The law was finally passed upon the propositon that so many hundreds of thousands of feet of water were to go through the locks at Lockport or be sent down from Chicago, so that the water of the Illinois river would not be polluted any more than the city of Chicago could possibly help. The matter at that time was compromised and, I believe, that law was passed by the legislature.

If a treaty were to restrict the flow of water, if we were to be the dumping ground of the sewage system of the city of Chicago without sufficient water to dilute it or carry it down further, I say, so far as our city is concerned, situated as we are, on a hill, with the great area of bottom territory overflowed in the spring or by the Illinois river, it would mean undoubtedly that a great deal of this matter would be deposited upon the bottom lands and more or less affect the health of our people.

I do not know what the sentiment of the Commission is. I do not know what the trouble is here, but on behalf of these people, we appeal to this Commission not to restrict the flow of water. The trouble with us has been and is now that the drainage trustees do not give us enough water.

General ERNST : That concludes the list of speakers, unless someone else desires to be heard.

Mr. E. J. WARD : I would like to say a few words, Mr. Chairman.

REMARKS by Mr. E. J. Ward, Marseilles, Illinois.

Mr. Chairman, as a resident for over fifty years of the Illinois valley, having lived along and upon the banks of the Illinois river for forty years, I wish to answer President McCormick's question, which he failed to answer—"What next"?

He said in substance, if the sanitary district should fail to turn down the amount of water stipulated in the organic laws of the district, "what next"? I will tell him what next.That same law contains a clause which provides, if the sanitary district does not turn down that amount of water, any municipality or individual in the state of Illinois can file the necessary information with our Attorney-General—and by the way this clause was put there at the behest of the valley people—any citizen can file the necessary information with our Attorney-General and then it becomes his duty to go before the Supreme Court and file mandamus proceedings to compel the sanitary district to turn down the flow necessary to protect our health ; and I can assure the gentlemen that if they fail to do it some municipality in that valley, or a combination of us, will certainly take advantage of that clause.

Now, gentlemen, the health of our little ones down in the valley depends upon that. We have reared them and we are rearing them there, and there are others yet to come. We ask you gentlemen not to restrict that flow, for if you do, really, in time we will not stand for it. These little ones will not, as they grow up, see themselves and their friends and their little ones carried to the cemetery for the sake of the sanitary district or for the sake of any treaty.

Gentlemen, without any disrespect to you, in the future, when those little ones grow up and learn that the enforcement of such a treaty is causing many of their own off-spring and their neighbors to die, in diplomatic language, you will find that the treaty has been outlawed.

General Ernst : Whom do you represent?

Mr. Ward : I do not represent any special place. I am a resident of the valley. I am from Marseilles. Our Mayor has spoken.

General Ernst : That completes the list.

Mr. Lindley : I wish to call the Commission's attention, and the attention of the lawyers particularly, to the decision of Justice Holmes in the Missouri-Illinois case, in the 200th U.S., and particularly to that portion of the decision which holds that we are within the watershed of the Mississippi, and that the Government brought us so, by the Legislative Acts of 1822 : and therefore the water has a right to flow that way.

General Ernst : If there is to be no further speaking the public session will now be closed.

(After a brief intermission, previous to the executive session, Mr. H. N. Ruttan asked the privilege of addressing the Commission and spoke as follows :)

Remarks by Mr. H. N. Ruttan.

Mr. Chairman and gentlemen, the question upon which I have been asked to address the Commission is the diversion of water from the headwaters of the Winnipeg river in Manitoba. I represent the city of Winnipeg, at the instructions of the Mayor. I am the City engineer of Winnipeg. On the river, at the present time, there are constructed and under construction water power plants to the extent of about 60,000 to 70,000 horsepower.

General Ernst : What river is this?

Mr. Ruttan : The Winnipeg river. The city of Winnipeg is now preparing plans and has voted the money for the construction of a 50,000 horsepower plant, from which power is to be transmitted a distance of 75 miles into the City of Winnipeg, and there are several other large developments going on upon that river, in some of which Chicago companies are largely interested.

It has come to the knowledge of the city of Winnipeg that the Minnesota Canal Company proposes to devote a portion of the headwaters of the Winnipeg river from that river into the St. Lawrence water-shed and that an application has been made to your commission for permission to make that diversion. The city of Winnipeg is, of course, very much opposed to any water being diverted from the water-shed to which it naturally belongs. And I might mention that a gauging of the Winnipeg river at the proposed site of the power works being constructed by the city of Winnipeg, showed a flow of 19,000 cubic feet a second.

It is assumed that at some time the water had been slightly more than that and that the minimum flow had been taken at about 17,000 cubic feet per second. We have not had a direct statement as to the amount of water which the Minnesota Canal Company proposes to divert, but I will give you these figures in order that you may judge it should they be allowed to take away the water as it is proposed to do.

I have nothing more to say except that between Fort Francis, where a large car company is constructing a power plant, and the city, the fall is somewhere about 300 feet. So you will be able to estimate the value of that river for power purposes. And I will call your attention to the fact that it has a particular value because coal in the prairie district surrounding Winnipeg is a very expensive commodity and our only hope of inducing manufacturers into that district is to develop the water power.

LIST OF ADDRESSES BY

William Duff Haynie, Representing Illinois Manfrs. Assn.
David E. Forgan, President of Chicago Commercial Association.
Commissioner Gibbons.
B. A. Eckhart, President of Chicago Board of Trade.
Franklin H. Head, Representing The Commercial Club.
Frank G. Hoyne, Representing Chicago Real Estate Board.
John G. Gilchrist, Representing Chicago Industrial Club.
E. J. Ward of Marseilles, Illinois.
H. B. McKahin, Mayor of Marseilles, Illinois.
Charles E. Hook, Mayor of Ottawa, Illinois.
Mr. C. A. Noble, Representing the Mayor of Joliet, Illinois.
George Bedford, Representing the Mayor of Morris, Illinois.
THE GOVERNOR OF ILLINOIS, Represented by Isham Randolph
Robert R. McCormick, President, Chicago Sanitary District
E. C. Lindley, Attorney for Sanitary District of Chicago.
Stephen Foster, Representing the Calumet River Basin.
Walter Panneck, Mayor of La Salle, Illinois.
E. J. Ward, of Marseilles, Illinois.
H. N. Ruttan, City Engineer of Winnipeg, Manitoba.

1913

PROPOSED DAM AT THE OUTLET OF LAKE ERIE.

Final Report of the International Waterways Commission on the Matter.

International Waterways Commission,
Office of American Section,
Buffalo, N.Y., June 20, 1913.

The honourable Minister of Public Works of Canada:

The honourable Secretary of War of the United States:

1. The act of the Congress of the United States which requested that the Government of Great Britain be invited to join in the formation of the International Waterways Commission defined one of the duties of that commission as follows:

'The said commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation, and if such structure is deemed advisable, shall make recommendations to their respective Governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof.'

2. It so happens that the term 'dam' may apply to various works of which the character and object are very different. At the time of passing the act Congress had under consideration the report of the board of engineers upon deep waterways between the Great Lakes and Atlantic tidewaters, dated June 30, 1900, in which it was recommended that the level of Lake Erie be 'regulated'—that is, that its oscillations be reduced— by means of a dam consisting of a submerged weir and of a set of sluice gates placed at its outlet near the head of the Niagara River. The object of these works would have been to raise the low-water surface of the lake without raising the high water, thus completely regulating its level.

It seems probable that this was the kind of works which Congress had in mind when using the term 'dam.' But the term "dam" may also be applied to a submerged weir without sluice gates, the object of which would be to raise the level of the lake at low water as well as at high water almost to an equal amount, though in the study of the question it was found possible to give the dam a form which will accomplish a partial regulation.

To distinguish works of this latter kind from those designed to 'regulate' the lake, they may be called 'compensating works.' Thus, the subject has two branches—one, the complete regulation of Lake Erie, and the other, the raising of its level without complete regulation.

3. Naturally, consideration of the complete regulation of the lake was taken up first. It was the subject of our report, dated January 8, 1910, which was printed and distributed by this commission, and was also published by the United States Government as House Document No. 779, Sixty-first Confgress, second session. A few of the statements made, as well as the conclusions reached, in that report, will bear repetition here.

4. The Great Lakes, with their connecting channels, constitute the most important system of inland navigation in the world. The traffic which passed

through Detroit River, its busiest link, in 1910 amounted to 73,526,602 tons, valued at about $771,000,000. About 80 per cent of this traffic is carried in large freight carriers, which are loaded down to the greatest draft that can be carried into the harbours or through the channels between the Lakes, but could be loaded much deeper if the depth of water permitted. Some of the larger of these vessels carry an additional load of 85 tons for each inch of additional draft. Every inch added to the available depth of water would therefore be of material benefit to commerce.

5. The Great Lakes constitute a series of enormous natural reservoirs, each of which serves to regulate the flow in the river constituting its outlet and to maintain the lake below. They are interdependent. The study of one, to be complete, must include the study of all. The total area drained by them is about 287,688 square miles, an area considerably larger than the German Empire. Of this total, about one-third is occupied by the Lakes themselves—that is, devoted to reservoir purposes. The result is a uniformity of level and a uniformity of flow which are truly wonderful—a perfection of regulation which no work of man ever did or ever will approach. The question propounded was, 'Can the degree of ularetion progvided by nature be improved?' Enormous forces were to be dealt with, and the results were to be measured in inches. The subject was, therefore, as difficult as it was important.

6. Soon after the organization of the commission a committee of two of its engineer members was appointed to collect all of the available data and to make an hydraulic analysis of the general regulation of all the lakes. All existing records of water-level observations and discharge measurements made since 1860 were collected, analyzed, tabulated, and studied. After a careful consideration of all the data, the commission found that only a very moderate degree of improvement in regulation over what nature provides is practicable in any of the lakes, and that, such as it is, this improvement is obtained at the expense and to the injury of the channels below. In the case of Lake Erie it would be possible to raise the extreme low-water stage about 1 foot, and this in turn would raise the low-water stages of Lake St. Clair about 0.61 foot and of Lake Huron-Michigan about 0.27 foot, all without appreciable increase in the extreme high stages. But in doing this the low-water stage of Lake Ontario would be lowered about $4\frac{1}{2}$ inches, the available depth in the St. Lawrence Canals would be diminished about $7\frac{2}{3}$ inches, and the city of Buffalo would suffer by increased damage from floods and by a postponement of the date of opening navigation in the spring. The question of damage to vested rights was thus introduced. While the advantages of regulation might outweigh the disadvantages if the persons who were to benefit from the former were identical with those who were to suffer from the latter, the difference was not great enough to justify the two Governments in entering upon the vexatious question of damages. The commission therefore recommended that the 'regulation' of Lake Erie be not undertaken, meaning thereby the most complete practicable regulation such as can be secured by a dam and sluice gates located at or near Buffalo.

7. The second branch of the subject committed to us, or works to raise the level of Lake Erie with partial but not complete regulation, which we have called 'compensating' works, is the subject of this report. Appended hereto is the report of the committee specially charged with the investigation.

8. As was stated in our former report, the Niagara River at its extreme upper end is an important safety valve for the protection of Buffalo from the effect of storms, and should not be obstructed by a dam, but it seemed possible that somewhere in the river, between Lake Erie and the Falls, a submerged dam might be placed which would greatly benefit the navigation of the waters above without injury to those below and with only minor damages, if any, to the

adjoining lands. To determine this question it was necessary to make a complete survey of the Niagara River from Lake Erie to the Falls, including the topography of the adjoining lands. This survey was made by the commission. A survey was made also by the Canadian Government of the Welland River, in Canada, which enters the Niagara about a mile above the rapids approaching the Falls. A sketch upon a reduced scale, showing the Niagara River in outline, is appended. (Pl. I.)

9. From a study of the maps it appears that the best site for a submerged dam, or weir, is just above the Welland River, extending from Hog Island, at the mouth of that river, to the mouth of Gill Creek, on the American side, as shown on Plate II. As the Welland is a navigable stream, there would be some advantage in placing the weir below its mouth, but the survey of that river showed that a moderate increase in the height of its surface would submerge a considerable area of valuable land. To provide for the navigation of the Welland it is necessary to construct a lock at the Canadian end of the weir. The object of placing the weir as near as possible to the foot of navigation is to improve all of the navigable portion of the Niagara River above. A study of the topography on both sides of the Niagara River showed that the water surface at mean stage could be raised as much as 3 feet at the site of the weir without inflicting damage upon adjacent lands, except for a distance of about 1½ miles immediately above the weir on the American side. At this place it is proposed to construct a levee of suitable height to protect the land from overflow.

10. The form to be given the weir has been the subject of careful investigation. In order to disturb as little as practicable the natural distribution of flow through the different parts of the cross section of the river, the crest of the weir is broken into four sections, as shown on Plate VI, the height given to each section being such as will raise the surface of the water in that section 3 feet at mean stage.

11. A cross section of the weir is shown in figure 1, Plate V. This form was adopted after experiment with various types of weir made under as nearly as possible true river conditions. The experiments were made at the hydraulic laboratory of the college of civil engineering at Cornell University, which was generously placed at the disposal of the commission for the purpose by the authorities of the university. They are described in the report of the committee, here appended. The type of weir desired is one which shall be very efficient at high stages of the river, and much less so at low stages. The form adopted fulfills these conditions, though it is quite possible that a still better form may be developed with further experiment.

12. The effects of the weir upon the Niagara River at different places and upon Lake Erie at low, mean, and flood stages are shown upon Plates III and IV, the former through the Tonawanda Channel and the latter through the Chippewa Channel. The plates show the natural surfaces at these three stages, and also the backwater surfaces caused by the weir as computed by Bernouilli's theorem for steady flow. The effects are also given in Table No. 1. It appears from this table that the level of Lake Erie will be raised 0·51 foot at extreme low stage, 0·39 foot at mean stage, and 0·11 foot at extreme flood stage. A low water the surface of the Niagara River will be raised 1·08 feet at the Buffalo waterworks; 1·66 feet at Strawberry Island, about 5½ miles from the lake; 2·14 feet at Black Creek, about 11 miles from the lake; 2·99 feet at La Salle Landing, about 18 miles from the lake; and 3·05 feet at Schlosser's Dock, the foot of navigation. At flood stage these numbers are: For Buffalo waterworks, 0·19 foot; for Strawberry Island, 0·42 foot; for Black Creek, 0·59 foot; for La Salle Landing, 0·82 foot; and for Schlosser's Dock, 0·91 foot.

13. The effect of raising the mean level of Lake Erie 0·39 foot would be to raise the mean level of Lake St. Clair about 0·23 foot; and the mean level of Lake Huron about 0·09 foot.

14. To change the level of a great inland sea like Lake Erie, upon the shores of which are many populous cities, is a matter to be approached with caution. Any important increase in the height of the high-water level may cause serious damage to the wharves and low-lying lands. Care must be taken to avoid injury to vested rights. In this case, the ordinary high-water level is increased only 0·38 foot, or 4½ inches, and the extreme flood stage at Buffalo is increased only 0·11 foot, or 1⅓ inches.

15. The construction of the weir recommended in this report will affect to some extent the levels in the first reach of the Barge Canal from Tonawanda to Lockport. The level of the Niagara River at Tonawanda would be raised by 1·71 feet at mean stage, and by 0·55 foot at flood stage, so that inasmuch as no provision has been made at the entrance of the canal against the rise which the construction of the weir will cause, it is in our opinion necessary to provide for the construction of a guard lock, the cost of which is included in our general estimate.

16. It is our opinion that the capacity of the lock to enter the Welland River is a domestic question to be decided by the Canadian Government. We have introduced an item of $500,000 in the estimates to provide for the construction of that lock, but its dimensions should conform to the capacity which the Canadian Government shall determine to give to the connecting waterways, and this estimate can be regarded only as a rough approximation.

17. The weir is to be constructed of concrete and its cost is estimated as follows:

Rock excavation, 36,300 cubic yards, at $4 per yard	$ 145,200
Concrete, superstructure, 44,000 cubic yards, at $12 per yard	528,000
Concrete, substructure, 48,500 cubic yards, at $10 per yard	485,000
Cofferdam, 105,500 cubic yards, at $3.50 per yard	369,250
Pumping and maintenance, lump sum	210,000
Lock into Welland River	500,000
Guard lock at Tonawanda	500,000
Excavation for retaining walls along Niagara River, 16,000 cubic yards, at $3 per yard	48,000
Concrete for retaining walls, 12,500 cubic yards, at $10	125,000
	$2,910,450
Add for engineering and contingencies about 20 per cent	589,550
Total	$3,500,000

18. The great value to the navigation interest of an increase of 6 inches in the low-water depth of Lake Erie has already been pointed out. The improvement of Niagara River to be effected by the proposed weir is important. An incidental advantage in its construction is that it would eliminate the possibility of the power companies at the Falls having any injurious effect upon the level of Lake Erie. The Niagara River below the weir and the conditions upon Lake Ontario and the St. Lawrence River would remain without appreciable change. The weir has small regulating effect upon the levels of Lake Erie, the range of the oscillations of the lake being reduced about 4½ per cent. The average natural low stage, 571·3, is raised 0·45 foot, and the average natural high stage is raised 0·38 foot, a difference of 0·07 foot. The storage in Lake Erie is reduced only by that amount, which is not sufficient to affect the level of Lake Ontario seriously.

19. It is possible that the Canadian Government may prefer to assume the damages from overflow in the valley of the Welland River, which would be caused by placing the Canadian end of the proposed weir below the mouth of the Welland, and thus make the lock unnecessary. If so, provision for this should be made in any treaty.

20. The commission believes that the very great advantages to navigation interests will justify and amply repay the necessary expenditure, and we recommend that a treaty be entered into between Great Britain and the United States providing for the construction of the weir.

O. H. ERNEST,
Brigadier General U. S. Army,
Retired,
Chairman American Section.
GEORGE CLINTON,
Member American Section.
E. E. HASKELL,
Member American Section.
Attest. W. EDWARD WILSON,
Secretary American Section.

GEO. C. GIBBONS,
Chairman Canadian Section.
LOUIS COSTE,
Member Canadian Section.
WM. J. STEWART,
Member Canadian Section.
Attest. THOMAS CÔTÉ,
Secreatry Canadian Section.

TORONTO, ONTARIO, December 13, 1912.

THE INTERNATIONAL WATERWAYS COMMISSION:

Your committee, which was appointed to investigate the advisability of locating a dam at the outlet of Lake Erie and the maintenance and regulation of suitable levels on the other lakes in the Great Lakes system, closed its report of December 4, 1909, upon this subject with the following paragraph:

'Your committee had hope to present a discussion of a project for compensating Lake Erie for the loss of level due to diversions by works placed above the rapids approaching Niagara Falls. A preliminary examination, however, revealed a lack of data which prevents consideration of the question at this time.'

Your committee now has the honour to submit a report upon this question, thereby completing the duties assigned it.

It may be well at this point to quote a part of the act of the Congress of the United States approved June 13, 1902, to more clearly understand this report:

'SEC. 4. That the President of the United States is hereby requested to invite the Government of Great Britain to join in the formation of an international commission, to be composed of three members from the United States and three who shall represent the interests of the Dominion of Canada, whose duty it shall be to investigate and report upon the conditions and uses of the waters adjacent to the boundary lines between the United States and Canada, including all of the waters of the Lakes and rivers whose natural outlet is by the River Saint Lawrence to the Atlantic Ocean; also, upon the maintenance and regulation of suitable levels; and, also, upon the effect upon the shores of these waters and the structures thereon, and upon the interests of navigation, by reason of the diversion of these waters from or change in their natural flow; and, further, to report upon the necessary measures to regulate such diversion, and to make such recommendations for improvements and regulations as shall best subserve the interests of navigation in said waters. The said commissioners shall report upon the advisability of locating a dam at the outlet of Lake Erie, with a view to determining whether such dam will benefit navigation; and if such structure is deemed advisable, shall make recommendations to their respective Governments looking to an agreement or treaty which shall provide for the construction of the same, and they shall make an estimate of the probable cost thereof.'

Niagara River is the outlet of Lake Erie and discharges into Lake Ontario; it is divided into two reaches by the Falls, the 'upper' and the 'lower.' The upper reach is navigable from Lake Erie to Chippewa, Ontario, and to Niagara Falls, N.Y., and is the reach with which we are at present concerned. Strawberry and Grand Islands divide a part of this reach into two channels, known as Tonowanda and Chippewa. The distance from Lake Erie to the head of Strawberry Island is approximately 4 miles and the fall in this distance at mean stage is 5·8 feet. The distance from the head of Strawberry Island to the end of navigation by the Tonawanda Channel is 16½ miles, and between the same points by the Chippewa Channel is 12¾ miles. The fall in these reaches at mean stage is 4·8 feet.

The natural conditions in this upper reach of river are therefore such as to indicate that by placing a submerged weir of proper size at the end of navigation, or below Navy and Connors Islands, it might be possible to create sufficient backwater to restore to Lake Erie a part, at least, of what it has lost in stage by diversions, and at the same time greatly improve the navigation of the reach of river under consideration.

It was this project that your committee had in mind when it closed its report on December 4, 1909. Naturally, the question arises: Can the water be raised sufficiently at the location indicated to actually restore to Lake Erie a quantity worth while and at the same time keep within control all flood waters, particularly those that come from heavy southwest windstorms on Lake Erie?

To answer this question it was necessary to have more data than existed at the time of our previous report. A careful topographic survey was required of all lands likely to be affected and a type of wier best suited for the location and conditions had to be determined.

Surveys were started early in 1910 and prosecuted as diligently as the affairs of the commission would permit. The results from these did not become available, however, until about the beginning of the present year. A detailed topographic survey was made of the shores of the Niagara from Lake Erie to within a mile of the Falls; the islands within this reach; and of the Welland River from its mouth to its source, a distance of about 40 miles.

In order to determine the best type of weir, it was deemed necessary to study various types under as nearly as possible true river conditions. These studies were made at the hydraulic laboratory of the college of civil engineering of Cornell University, the use of which was generously offered for this purpose. They covered experiments on seven different types, ranging in height from 3·7 to 6·02 feet and having in general a 3 to 1 upstream slope and a 1 to 1 downstream, five having a flat crest and the remainder a rounded crest. In two of the flat-top types, the upstream, and in all the downstream corners were rounded on a radius of 9·5 feet. On two of the flat-top and all of the round-top types, the downstream nappe was an ogee curve.

These experiments were conducted by Mr. E. E. Haslam, assistant engineer to the commission, and the results, which are given more in detail presently in this report, furnish what was being sought, namely, a type of submerged weir that would be very efficient at high stages and much less so at low stages.

Fortified with these new data, a study was made of the probable effect of submerged weirs placed at right angles to the general direction of the river in the following localities: Willow Island, Port Day, Grass Island, and Gill Island, as well as one on a line between Gill Creek and Hog Island, at the mouth of Welland River, all as shown on Plate II. Only the last of these met the conditions desired, and it is not thought necessary to give the results of the studies of the rejected locations because the end to be attained is clearly set forth in the consideration of the site finally chosen.

As shown in our previous report, the stage of water in several of the Great Lakes will be materially lowered by artificial diversions of water therefrom. This loss of level on Lake Michigan-Huron, if 10,000 c. f. s. be taken through the Chicago Drainage Canal, will for mean stage amount to $\frac{10,000}{18,900}=0\cdot53$ foot, while the loss of level to Lake Erie due to this diversion and 1,000 c. f. s. through the Erie Canal and 1,100 c. f. s. through the Welland Canal will at mean stage amount to $\frac{10,000}{23,400}=0\cdot43$ foot and $\frac{2,100}{23,400}=0\cdot09$ foot, respectively, a total of 0·52 foot. The American power companies have also lowered the level of Lake Erie probably by 0·08 foot.

The project here proposed for restoring the loss caused by these diversions is the construction of a submerged weir of suitable type, on a line between Gill Creek and Welland River, as shown on Plates I and II, of such a height of crest as will create sufficient backwater to offset it.

To determine this, backwater curves have been computed, based upon Bernoulli's theorem for steady flow, and these are shown on Plates III and IV, the former being for the Tonawanda and the latter for the Chippewa Channel. These plates and Table I show the natural stages of upper Niagara River for low, mean, and flood conditions and also the compensated stages and backwater for 3-foot backwater at mean stage, at the proposed Gill Greek-Welland River weir.

The backwater on Lake Erie caused by the submerged weir has also been computed by the supply, storage, and discharge method described on pages 53 and 54 of the commission's report upon the regulation of Lake Erie, dated January 8, 1910, and the results by the two methods check very satisfactorily, the latter giving 0·07 foot greater backwater in the high-water year of 1876 and 0·08 foot greater in the low-water year of 1895.

Owing to the fact that the weir has an increasing efficiency with increase in stage, it was thought that the flow of the river might vary slightly from present natural conditions and therefore might affect injuriously the stage of water in the St. Lawrence Canals. The computed results show that the effect on Lake Ontario of any variation in the flow from Lake Erie caused by the submerged weir would be negligible. See Tables II and III, the former for effect on Lake Erie, and the latter for effect on Lake Ontario.

The type of weir chosen, as best meeting requirements, is shown in cross section on Plate V, Figure I. The longitudinal profile of its crest is shown on plate VI where it will be seen it has been divided into four sections, and the weir crest for each section set at such an elevation that it will produce 3-foot backwater at mean stage with the same distribution of flow of water across the river under compensated conditions as under natural conditions.

This 3-foot rise in mean stage at the proposed weir would raise the level of Lake Erie by 0·51 foot at low stage (570); by 0·39 foot at mean stage (572·6);

and by 0·11 foot at flood stage (579·18). The increased stage of Lake Erie would decrease the slope in Detroit River and would cause Lake St. Clair to rise until the discharge through that river had a value equal to the present discharge under natural conditions. When this condition occurred Lake St. Clair would have risen in level by about 0·23 foot at mean stage. Likewise, the increased stage of Lake St. Clair would in turn decrease the slope in St. Clair River and Lake Huron-Michigan would rise until the slope became such as to produce a discharge in St. Clair River equal to its present discharge under natural conditions. This increased stage in Lake Huron-Michigan, corresponding to 572·6, mean level of Lake Erie, would be about 0·09 foot.

The discharge of the Niagara, corresponding to mean level of Lake Erie of 572·6 (see report on regulation of Lake Erie) and fall of 5·12 feet Lake Erie to Austin Street, Buffalo, is 209,100 c. f. s.; the low-water discharge for stage 570, and fall of 4·52 feet Lake Erie to Austin Street is 153,200 c. f. s.; and the flood discharge for stage 579·18 and fall of 6·42 feet Lake Erie to Austin Street is 376,700 c. f. s. It is this flood with which we are particularly concerned. By reference to Plates III, IV, and VI and Table I it will be seen that this compensated flood stage at the proposed weir would be 1·2 feet higher than the present natural flood stage at this point. The compensated flood stage at Tonawanda Island would be raised 0·55 foot above the present natural flood stage at this point.

Knowing the elevation of the flood waters of this new compensated flood stage from Lake Erie to the site of the proposed weir, the topographic surveys previously referred to were studied with a view to determining the effect that these new flood waters might have upon adjacent lands. So far as can be seen, but little, if any, damage would result from the proposed weir placed on the Gill Greek-Welland River Section. Our investigation has also shown that it would not be possible to raise the water at the weir by much more than 3 feet without danger of damage from floods.

It should be here stated that it was found impracticable to place this weir below the mouth of Welland River because of the large land areas that would be affected along this stream by increased stage of flood waters.

As Welland River is navigable and as there is a connection between the Welland Canal and the Niagara by this stream, it would be necessary to provide a lock at the Canadian end of the weir, as shown on Plate II.

The construction of the weir recommended in this report will affect to some extent the levels in the first reach of the Barge Canal, from Tonawanda to Lockport. The level of the Niagara River at Tonawanda would be raised by 1·71 feet at mean stage, and by 0·55 foot at flood stage, so that inasmuch as no provision has been made at the entrance of the canal against the rise which the construction of the weir will cause, it is in our opinion necessary to provide for the construction of a guard lock, the cost of which is included in our general estimate.

Having discussed the various engineering features of this project, we may now set forth the advantages that would result. First among these is the restoration to Lake Erie of 0·39 foot to its mean level. It is difficult to estimate this in money value, but it certainly would be many times the cost of the weir, in betterment of Lake Erie harbours and conditions at the mouth of Detroit River.

Secondly, it would greatly improve the navigation of the upper Niagara and thereby greatly benefit a locality which must sooner or later become a harbour or shipping port for important industries.

Thirdly, it would eliminate the possibility of the power companies at Niagara Falls having any injurious effect upon the stage of water in Lake Erie. The river below the weir would remain unchanged.

Fourthly, conditions on Lake Ontario and St. Lawrence River would remain unmolested.

Lastly, a bridge could be made a part of this weir, which would provide a free highway from one country to the other, open to the citizens of both.

ESTIMATE OF COST OF PROPOSED WEIR.

Rock excavation, 36,300 cubic yards, at $4 per yard	$ 145,200
Concrete, superstructure, 44,000 cubic yards, at $12 per yard	528,000
Concrete, substructure, 48,500 cubic yards, at $10 per yard	485,000
Cofferdam, 105,500 cubic yards, at $3.50 per yard	369,250
Pumping and maintenance, lump sum	210,000
Lock into Welland River	500,000
Guard lock at Tonawanda	500,000
Excavation for retaining walls along Niagara River, 16,000 cubic yards, at $3 per yard	48,000
Concrete for retaining walls, 12,500 cubic yards, at $10 per yard	125,000
	$2,910,450
Add for engineering and contingencies 20 per cent	582,090
Total	$3,492,540

SUBMERGED-WEIR EXPERIMENTS.

As previously stated in this report, submerged-weir experiments were made upon seven different types of weirs, ranging in height from 3·70 to 6·02 feet. All of the models were approximately 4 feet long. The following table, No. 4, gives the dimensions of the several models tested:

TABLE No. 4.—DIMENSIONS OF SUBMERGED-WEIR MODELS.

Model No.	Length.	Height.	Crest.	Width bottom.	Upstream face.	Down-stream face.	Remarks.
	Feet.	Feet.		Feet.			
1	4·005	6·02	Flat, 6 feet wide	31·76	1-3 slope...	1-1 slope...	Upstream corner sharp, downstream corner rounded, radius 9·5 feet.
2	4·01	4·53	"	25·79	" ..	" ..	" "
3	4·01	4·53	"	27·33	" ..	" ..	Up and down stream corners rounded, radius 9·5 feet.
4	4·02	5·17	Rounded, radius 9·5 feet.	27·70	" ..	" ..	Ogee curve downstream face.
5	4·005	4·35	"	23·50	" ..	" ..	Ogee curve bottom, downstream face.
6	4·005	3·70	Flat, 6 feet wide	23·50	" ..	" ..	Upstream corner sharp, downstream corner rounded, radius 9·5 feet Ogee curve bottom down stream face.
7	4·005	3·70	"	25·04	" ..	" ..	Up and down stream corners rounded, radius 9·5 feet. Ogee curve bottom downstream face.

These models were placed in a wooden flume 95·5 feet long, 10 feet high, and 4 feet wide, constructed in the open concrete canal of the hydraulic laboratory at Cornell University, Ithaca, N.Y. The dimensions of the canal are 418 feet long, 16 feet wide, and 10 feet deep. The grade of bottom of channel is approximately 1 foot in 500. A bulkhead located about 60 feet from upper end of canal divides it into two parts. A standard sharp-crested weir placed on top of this bulkhead measures the quantity of water flowing in canal. The wooden flume mentioned above was built in this canal, the upper end being located about 87 feet below the standard weir. The upper end of flume had a bell-shaped mouth, about 15 feet long, converging from 16 feet, the width of canal, to 4 feet, the width of flume. The crest of weir of tested models was placed about 46 feet below upper entrance to bell mouth. The flow of water over the standard weir, through the canal, and over the experimental models was regulated by gates at the head and foot of canal. By the manipulation of these gates various discharges, submergences, and heads on the experimental weir models were secured. The upstream head was measured in the flume with a plumb-bob attached to steel tape at a point about 25·5 feet above the upstream edge of crest of flat weir, while the downstream head was measured in the same way in still water behind the flume on both sides and about 16·6 feet downstream from the upstream edge of crest of flat weir. The longitudinal water surface curve over the weir was determined for all models under various conditions of flow. The flow of water over these experimental models varied between 27·6 and 203·2 second-feet, equivalent to 6·87 and 50·75 c. f. s. per linear foot of weir, respectively. The upstream heads on the weir varied between 1·66 and 6·35 feet and the ratio of submergences between 0 and 95. The experimental coefficients as derived are based upon the submerged wier formula $D=cF\frac{1}{2}\ H+\frac{d}{2}$, where D = discharge per linear foot of crest, H = upstream head, d = downstream head, F = fall or upstream head minus downstream head, c = experimental coefficient. The weir coefficients for the flat-crest models are given in Table 5 and are shown on Plate V.

TABLE NO. 5.—WEIR COEFFICIENTS, FLAT-TOP MODEL.

Weir condition.	Average minimum river flow per linear foot of weir.	Coefficient.	Average mean river flow per linear foot of weir.	Coefficient.	Average maximum river flow per linear foot of weir.	Coefficient.
	C.f.s.		C.f.s.		C.f.s.	
Free	18·00	3·120	25·00	3·160	45·00	3·260
0·1 submergence	18·00	3·145	25·00	3·190	45·00	3·300
0·2 submergence	18·00	3·195	25·00	3·245	45·00	3·345
0·3 submergence	18·00	3·260	25·00	3·308	45·00	3·419
0·4 submergence	18·00	3·340	25·00	3·397	45·00	3·500
0·5 submergence	18·00	3·480	25·00	3·540	45·00	3·655
0·6 submergence	18·00	3·720	25·00	3·780	45·00	3·900
0·7 submergence	18·00	4·125	25·00	4·190	45·00	4·320
0·8 submergence	18·00	4·850	25·00	4·910	45·00	5·060
0·9 submergence	18·00	5·930	25·00	8·025	45·00	6·210

The weir coefficients of the rounded-crest models were about 5 per cent greater than those of flat-crest models, but the coefficient increment was about the same for each type within the limits for river conditions. The flat-crest model was therefore adopted on account of the easier construction, inspection, and repair.

Plate VII is a diagram of submerged-weir coefficients for the flat-top model shown in Fig. I, on Plate V, based upon and derived from the experiments hereto described and made at the Cornell University hydraulic laboratory, Ithaca, N.Y., in November and December, 1911.

Your committee do not wish it understood that the type of weir here proposed is the most desirable one for the purpose. The experiments made were by no means sufficient to settle this question. It is very probable that further experiments would reveal a still better type. The one proposed does demonstrate however, that the project is feasible.

E. E. HASKELL,
Member American Section.
WM. J. STEWART,
Member Canadian Section.

Attest:
W. EDWARD WILSON, C.E.,
Secretary American Section.

TABLE NO. 1.—NATURAL AND COMPENSATED STAGES AND BACKWATER CURVES OF NIAGARA RIVER BETWEEN NIAGARA FALLS AND LAKE ERIE.

Niagara River sections.	Distance from Buffalo light.	Natural mean stage.	Compensated mean stage.	Backwater at mean stage.	Natural low stage.	Compensated low stage.	Corresponding backwater at low stage.	Natural flood stage.	Compensated flood stage.	Corresponding backwater at flood stage.
	Feet.			Feet.			Feet.			Feet.
Buffalo Breakwater Light, Lake Erie	0	572·60	572·99	0·39	570·00	570·51	0·51	579·18	579·29	0·11
Old Fort Erie, opposite angle Bird Island Pier	7,000	571·88	572·32	·44	569·31	569·92	·61	578·39	578·51	·12
Fort Porter	10,250	570,48	571·07	·59	567·98	568·79	·81	576·80	576·96	·16
Waterworks	11,350	569·34	570·08	·74	566·87	567·95	1·08	575·39	575·58	·19
Albany Street	12,500	568·34	569·25	·91	565·97	567·20	1·23	574·33	574·57	·24
Ferry Street	14,000	568·14	569·18	1·04	565·83	567·16	1·33	574·00	574·29	·29
Austin Street	21,700	567·36	568·52	1·16	565·23	566·68	1·45	572·76	573·09	·33
Strawberry Island	29,200	566·85	568·24	1·39	564·74	566·40	1·66	572·18	572·60	·42
Black Creek (Chippewa Channel)	57,000	565·65	567·49	1·84	563·91	566·05	2·14	570·06	570·65	·59
Tonawanda Island	64,900	565·91	567·62	1·71	563·91	566·05	2·14	570·98	571·53	·55
La Salle Landing	93,000	564·16	566·48	2·32	562·42	565·41	2·99	568·57	569·39	·82
Schlosser's Dock:										
Via Tonawanda Channel	107,500	563·82	566·33	2·51	562·29	565·34	3·05	567·70	568·61	·91
Via Chippewa Channel	85,700									
Gill Creek-Welland River Weir section:[1]										
Via Tonawanda Channel	112,800	[1]562·98	565·98	3·00	[1]561·50	565·11	3·61	[1]566·55	567·75	1·20
Via Chippewa Channel	90,700									
Grass Island:										
Via Tonawanda Channel	115,300	561·98	561·98	0	560·62	560·62	0	565·66	565·66	
Via Chippewa Channel	93,200									
Willow Island:										
Via Tonawanda Channel	119,100	560·30	560·30	0	559·20	559·20	0	562·68	562·68	
Via Chippewa Channel	97,000									

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[1] Not observed gauge readings; obtained by interpolation.

TABLE No. 2.—COMPENSATION OF LAKE ERIE IN HIGH-WATER YEAR 1876 AND LOW-WATER YEAR 1895.

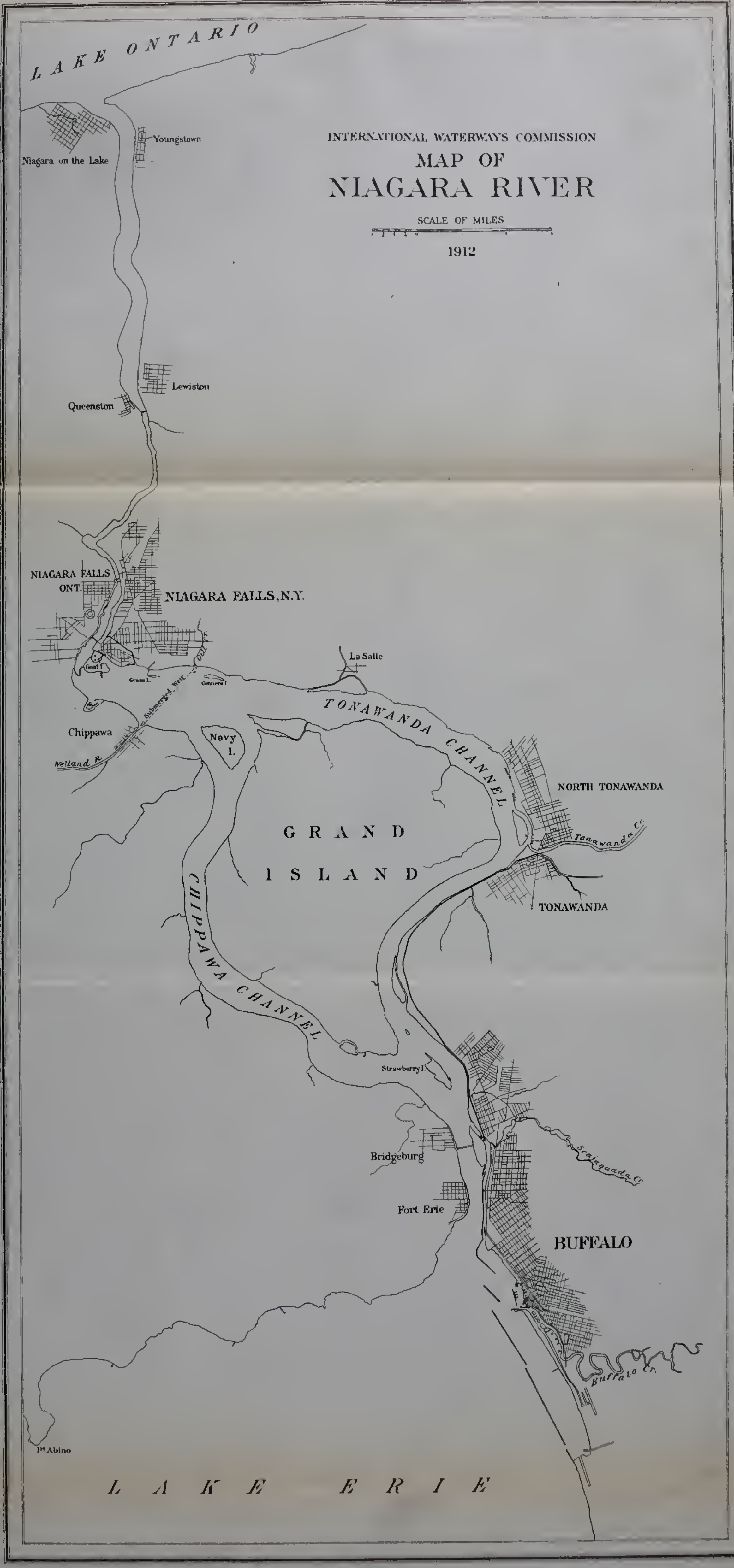
Date.	Water levels of Lake Erie.				Storage in Lake Erie.		Niagara River discharge. 100 c.f.s.	Total supply Lake Erie. 100[1] c.f.s.	Natural water levels Gill-Creek-Welland River weir section.		Compensated lake level. Buffalo N.Y., first of month.	Compensated Outflow Niagara River, 100 c.f.s., first of month.	Compensated storage in Lake Erie.		Compensated lake level, Buffalo, N.Y., mean of month.	Compensated outflow Niagara River, mean of month, 100 c.f.s.	Compensated discharge minus natural discharge Niagara River, 100 c.f.s. mean of month.
	Cleveland, Ohio.		Buffalo, N.Y.														
	First of month.	Mean of month.	First of month.	Mean of month.	Foot depth.	100 c.f.s.			First of month.	Mean of month.			100 c.f.s.	Foot depth.			
1876.																	
January	572·38	572·36	572·70	572·61	+0·26	+275	2,081	2,356	563·04	562·99	573·09	2,104	+252	+0·212	573·20	2,132	+51
February	572·64	572·92	572·78	572·95	+ ·60	+634	2,162	2,796	563,08	563·17	573·30	2,158	+638	+ ·536	573·57	2,226	+64
March	573·24	573·57	573·25	573·55	+ ·59	+624	3,311	2,935	563·35	563·51	573·84	2,295	+640	+ ·538	574·11	2,367	+56
April	573·83	574·09	573·78	574·00	+ ·42	+444	2,425	2,869	563·64	563·76	574·38	2,440	+429	+ ·360	574·56	2,490	+65
May	574·25	574·41	574·16	574·31	+ ·21	+222	2,507	2,729	563·85	563·93	574·71	2,540	+189	+ ·159	574·82	2,563	+56
June	574·46	574·52	574·40	574·49	·00	0	2,557	2,557	563·98	564·03	574·90	2,585	− 28	− ·024	574·89	2,582	+25
July	574·46	574·41	574·47	574·45	− ·20	−211	2,546	2,335	564·02	564·01	574·88	2,579	−244	− ·205	574·78	2,552	+ 6
August	574·26	574·11	574·26	574·07	− ·24	−251	2,444	2,190	563·91	563·80	574·67	2,520	−330	− ·277	574·53	2,483	+39
September	574·02	573·94	574·02	573·96	− ·34	−360	2,414	2,054	563·77	563·74	574·39	2,443	−389	− ·327	574·23	2,398	−16
October	573·68	573·41	573·72	573·49	− ·23	−243	2,296	2,053	563·61	563·48	574·06	2,353	−300	− ·252	573·94	2,321	+25
November	573·45	573·49	573·58	573·68	− ·13	−137	2,344	2,207	563·53	563·58	573·81	2,287	− 80	− ·067	573·78	2,280	−64
December	573·32	573·15	573·60	573·53	− ·37	−391	2,306	1,915	563·54	563·50	573·74	2,270	−355	− ·298	573·57	2,226	−80
1895.																	
January	571·40	571·23	571·76	571·69	− ·28	−296	1,875	1,579	562·51	562·47	572·20	1,890	−311	− ·268	572·06	1,858	−17
February	571·12	571·00	571·34	571·00	− ·12	−127	1,728	1,601	562·27	562·08	571·93	1,829	−228	− ·197	571·83	1,807	+79
March	571·00	571·01	570·96	570·92	+ ·14	+148	1,712	1,860	562·06	562·04	571·73	1,784	+ 76	+ ·006	571·76	1,791	+79
April	571·14	571·26	571·02	571·13	+ ·23	+243	1,756	1,999	562·09	562·16	571·80	1,800	+199	+ ·172	571·88	1,818	+62
May	571·37	571·48	571·30	571·48	+ ·15	+159	1,829	1,988	562·25	562·35	571·97	1,838	+150	+ ·129	572·04	1,854	+25
June	571·52	571·57	571·53	571·58	·00	0	1,851	1,851	562·38	562·41	572·10	1,867	− 16	− ·014	572·10	1,867	+16
July	571·52	571·46	571·57	571·56	− ·10	−106	1,846	1,740	562·40	563·39	572·09	1,865	−125	− ·108	572·04	1.854	+ 8
August	571·42	571·38	571·49	571·42	− ·09	− 95	1,817	1,722	562·36	562·32	571·98	1,840	−118	− ·102	571·93	1,829	+12
September	571·33	571·28	571·43	571·44	− ·29	−307	1,821	1,514	562·33	563·33	571·88	1,818	−304	− ·262	571·75	1,789	−32
October	571·04	570 80	571·32	571·20	− ·29	−307	1,771	1,464	562·26	562·19	571·62	1,760	−296	− ·255	571·49	1,732	−39
November	570·75	570·70	570·96	570·71	+ ·03	+ 32	1,670	1,702	562·06	561·91	571·36	1,704	− 2	− ·002	571·36	1,704	+34
December	570·78	570·86	570·84	570·97	+ ·13	+137	1,723	1,860	561·99	562·06	571·36	1,704	+156	+ ·134	571·42	1,717	− 6

The flow of 1,000 c. f. s. through the Erie Canal and that of 1,100 e. f. s. through the Welland Canal have been omitted.

TABLE No. 3.—EFFECT OF COMPENSATION OF LAKE ERIE ON WATER LEVELS OF LAKE ONTARIO IN HIGH WATER YEAR 1876 AND LOW-WATER YEAR 1895.

Date	Natural water levels of Lake Ontario at Charlotte, N.Y.		Actual rise of lake during month, in feet.	Inflow from Niagara River.		Change of inflow to Lake Ontario due to compensating works.	Effect of change of inflow on level of Lake Ontario for month in feet.	Effect of change of outflow through St. Lawrence River on level of Lake Ontario, for month, in feet.	Total effect from hange of inflow and outflow on level of Lake Ontario, in feet	Compensated conditions.			Compensated level less natural level of Lake Ontario.	
	First of month.	Mean of month.		Natural condition 100 c. f. s.	Compensated condition. 100 c. f. s.	100 c. f. s.				Rise or fallduring month, in feet.	Stage of Lake Ontario first of month.	Stage of Lake Ontario mean of month.	First of month.	Mean of month.
1876.														
January	245·28	245·48	+0·52	2,081	2,132	+51	+0·056	0·000	+0·056	+0·576	245·280	245·568	0·000	+0·088
February	245·80	246·11	+ ·60	2,162	2,226	+64	+ ·070	− ·018	+ ·052	+ ·652	245·856	246·182	+ ·056	+ ·072
March	246·40	246·70	+ ·76	2,311	2,367	+56	+ ·061	− ·034	+ ·027	+ ·787	246·508	246·902	+ ·108	+ ·202
April	247·16	247·62	+ ·80	2,425	2,490	+65	+ ·071	− ·044	+ ·027	+ ·827	247·295	247·708	+ ·135	+ ·088
May	247·96	248·30	+ ·40	2,507	2,563	+56	+ ·061	− ·054	+ ·007	+ ·407	248·122	248·326	+ ·162	+ ·026
June	248·36	248·42	+ ·07	2,557	2,582	+25	+ ·027	− ·057	+ ·030	+ ·040	248·529	248·549	+ ·169	+ ·129
July	248·43	248·44	− ·20	2,546	2,552	+ 6	+ ·006	− ·047	− ·041	− ·241	248·569	248·448	+ ·139	+ ·008
August	248·23	248·02	− ·55	2,444	2,483	+39	+ ·042	− ·033	+ ·009	− ·541	248·328	248·058	+ ·098	+ ·038
September	247·68	247·35	− ·50	2,414	2,398	−16	− ·017	− ·035	− ·052	− ·552	247·787	247·511	+ ·107	+ ·161
October	247·18	247·00	− ·35	2,296	2,321	+25	+ ·027	− ·018	+ ·009	− ·341	247·235	247·064	+ ·055	+ ·061
November	246·83	246·66	− ·31	2,344	2,280	−64	− ·070	− ·020	− ·090	− ·400	246·894	246·694	+ ·064	+ ·034
December	246·52	246·39	− ·34	2,306	2,226	−80	− ·088	+ ·008	− ·080	− ·420	246·494	246·284	− ·026	− ·106
1895.														
January	244·54	244·55	− ·07	1,875	1,858	−17	− ·019	·000	− ·019	− ·089	244·540	244·496	·000	− ·054
February	244·47	244·39	− ·07	1,728	1,807	+79	+ ·088	+ ·006	+ ·094	+ ·024	244·451	244·463	− ·019	+ ·073
March	244·40	244·40	+ ·17	1,712	1,791	+79	+ ·088	− ·022	+ ·066	+ ·236	244·475	244·593	+ ·075	+ ·193
April	244·57	244·74	+ ·28	1,756	1,818	+62	+ ·069	− ·042	+ ·027	+ ·307	244·711	244·864	+ ·141	+ ·124
May	244·85	244·96	+ ·03	1,829	1,854	+25	+ ·028	− ·050	− ·022	+ ·008	245·018	245·022	+ ·168	+ ·062
June	244·88	244·79	− ·22	1,851	1,867	+16	+ ·018	− ·044	− ·026	− ·246	245·026	244·903	+ ·146	+ ·113
July	244·66	244·53	− ·26	1,846	1,854	+ 8	+ ·009	− ·036	− ·027	− ·287	244·780	244·636	+ ·120	+ ·106
August	244·40	244·26	− ·25	1,817	1,829	+12	+ ·013	− ·028	− ·015	− ·265	244·493	244·360	+ ·093	+ ·100
September	244·15	244·04	− ·31	1,821	1,789	−32	− ·035	− ·023	− ·058	− ·368	244·228	244·044	+ ·078	+ ·004
October	243·84	243·64	− ·32	1,771	1,732	−39	− ·043	− ·006	− ·049	− ·369	243·860	243·676	+ ·020	+ ·036
November	243·52	243·41	− ·06	1,670	1,704	+34	+ ·038	+ ·008	+ ·046	− ·014	243·491	243·484	− ·029	+ ·074
December	243·46	243·51	+ ·18	1,723	1,717	− 6	− ·007	− ·005	− ·012	+ ·168	243·477	243·561	+ ·017	+ ·051

PLATE I



INTERNATIONAL WATERWAYS COMMISSION

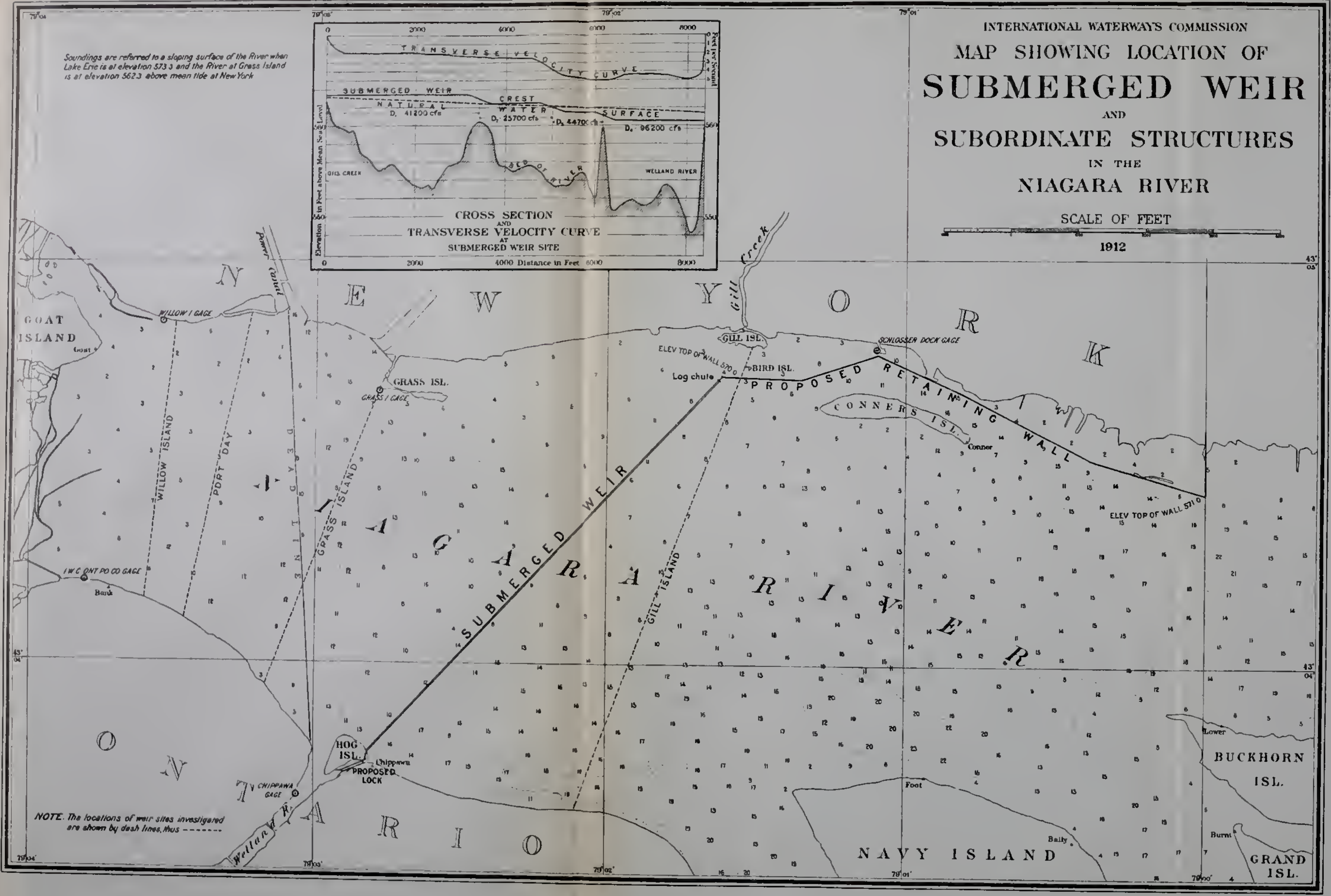
MAP OF

NIAGARA RIVER

SCALE OF MILES

1912

PLATE II



INTERNATIONAL WATERWAYS COMMISSION

MAP SHOWING LOCATION OF SUBMERGED WEIR AND SUBORDINATE STRUCTURES IN THE NIAGARA RIVER

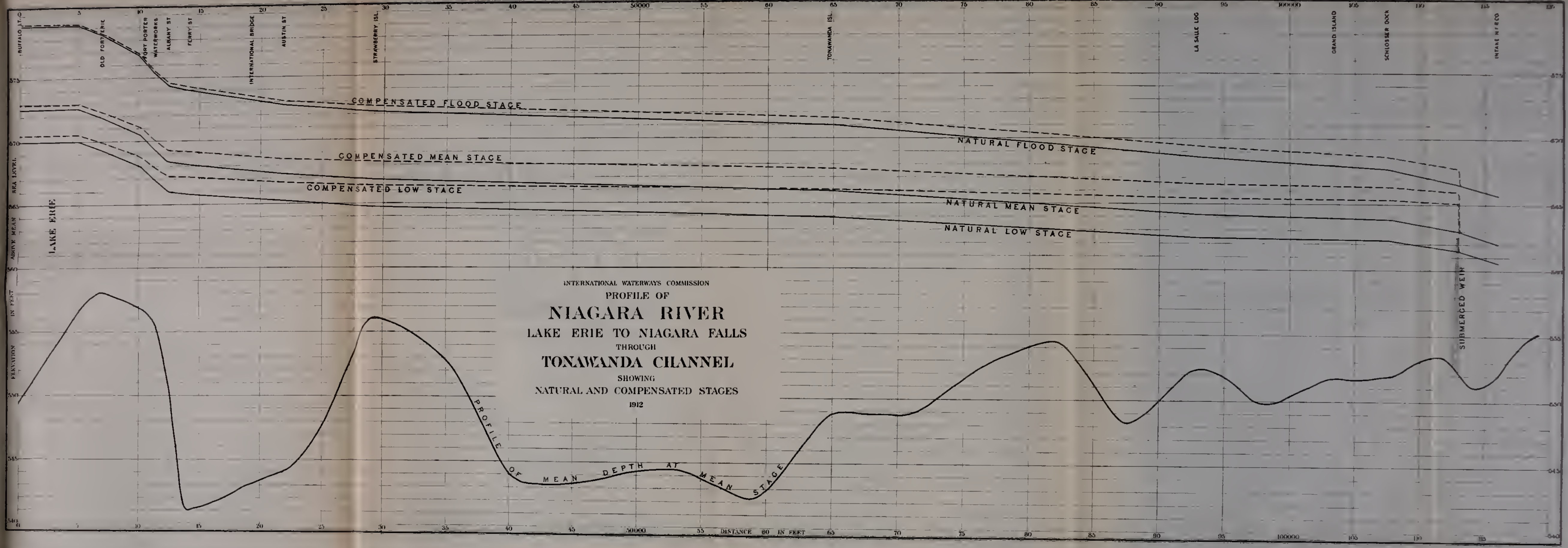
SCALE OF FEET

1912

Soundings are referred to a sloping surface of the River when Lake Erie is at elevation 573.3 and the River at Grass Island is at elevation 562.3 above mean tide at New York

NOTE. The locations of weir sites investigated are shown by dash lines, thus -------

PLATE [illegible]



INTERNATIONAL WATERWAYS COMMISSION

PROFILE OF

NIAGARA RIVER

LAKE ERIE TO NIAGARA FALLS

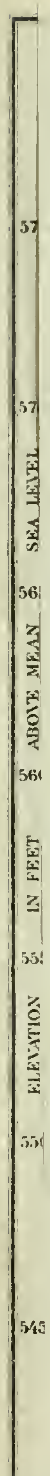
THROUGH

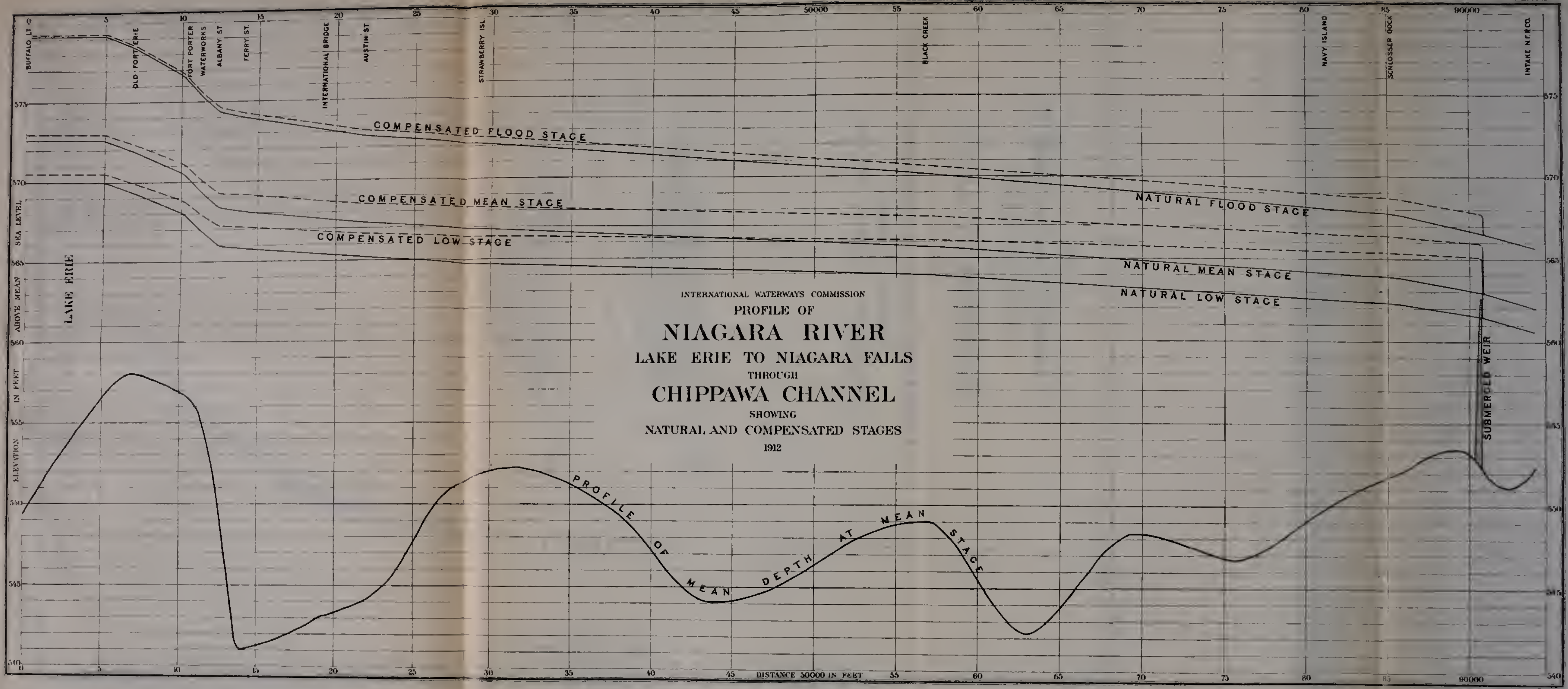
TONAWANDA CHANNEL

SHOWING

NATURAL AND COMPENSATED STAGES

1912


ELEVATION IN FEET ABOVE MEAN SEA LEVEL
57
57
56
56
55
55
545
540



INTERNATIONAL WATERWAYS COMMISSION

PROFILE OF

NIAGARA RIVER

LAKE ERIE TO NIAGARA FALLS

THROUGH

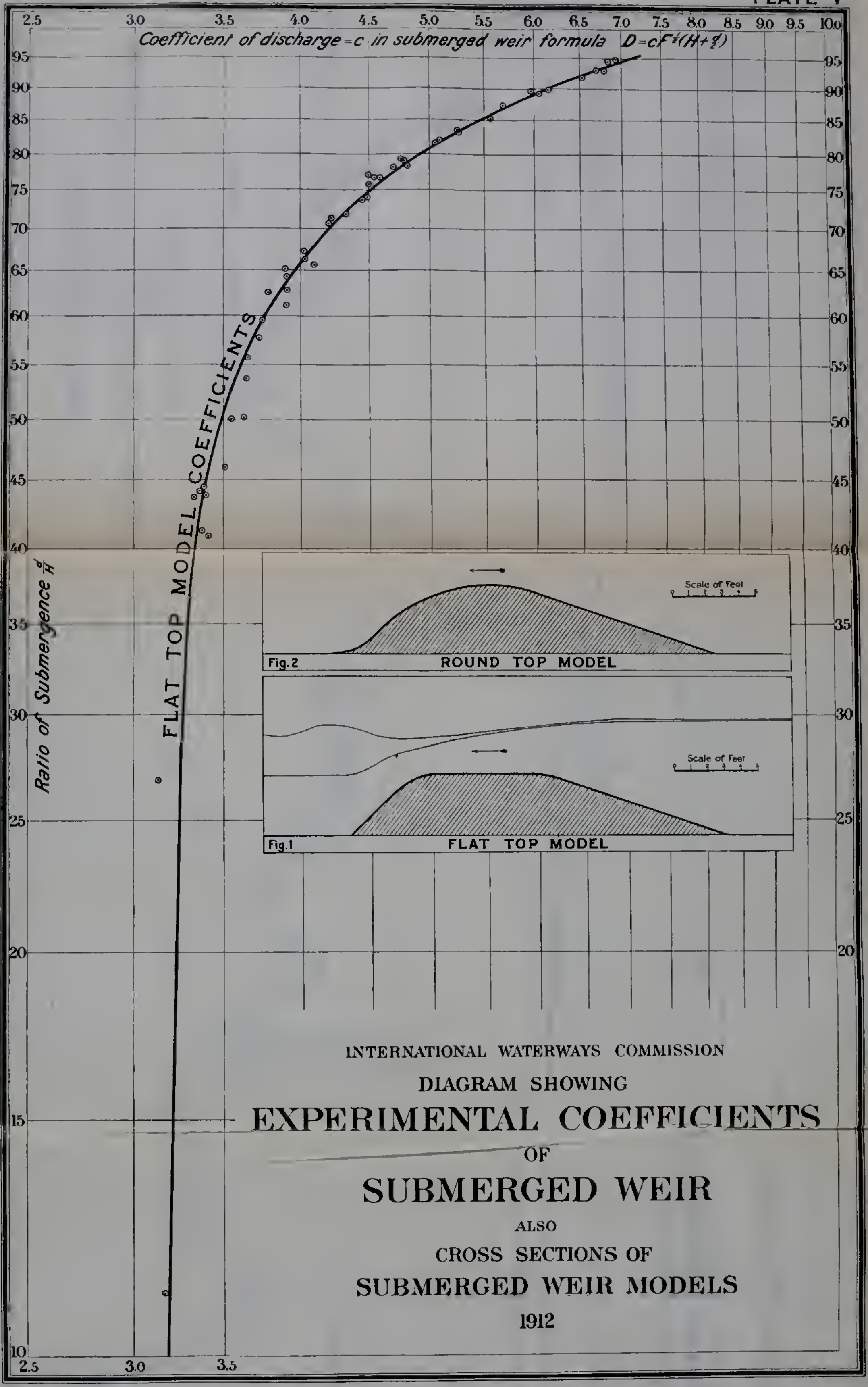
CHIPPAWA CHANNEL

SHOWING

NATURAL AND COMPENSATED STAGES

1912

PLATE V

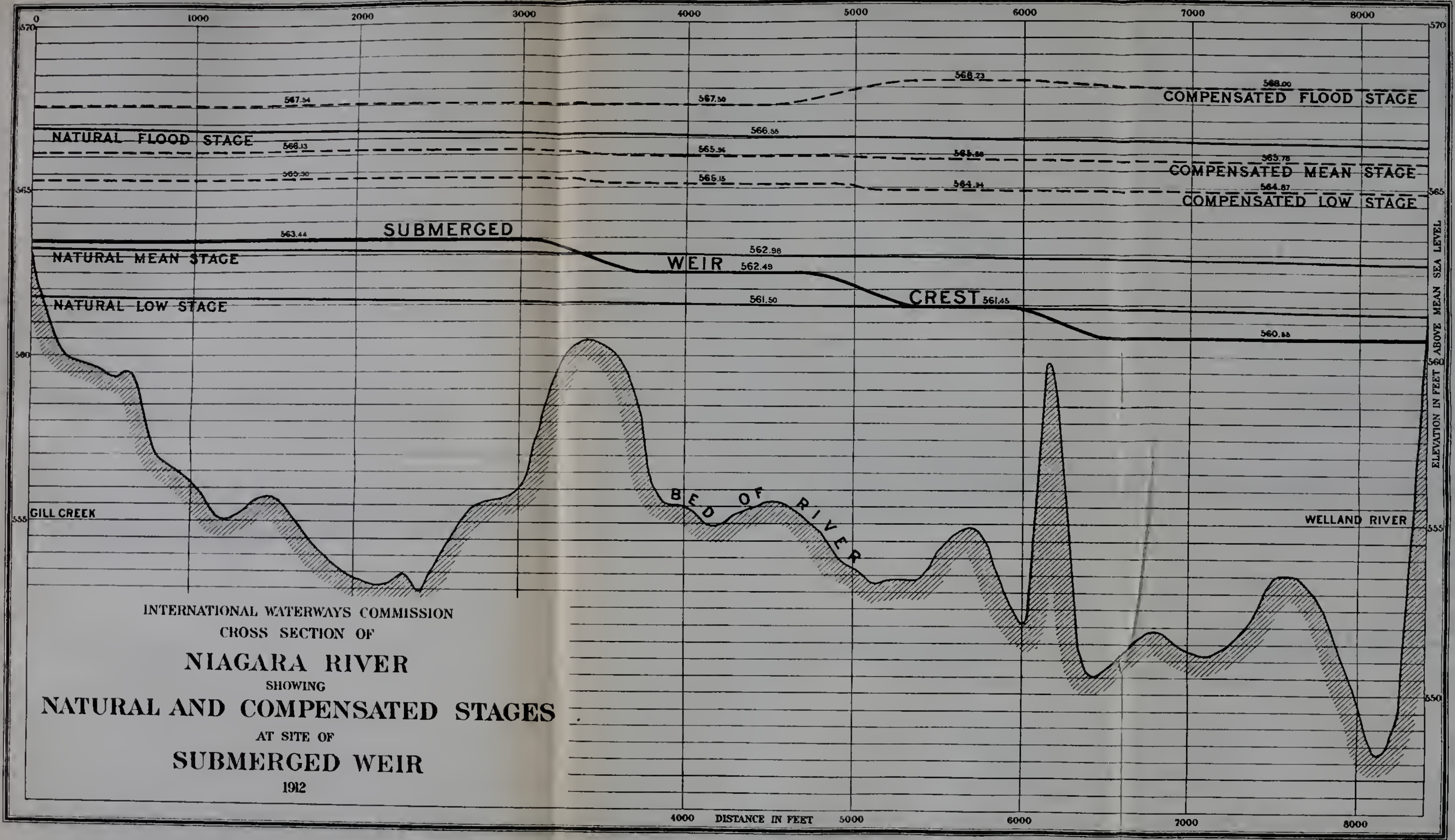


INTERNATIONAL WATERWAYS COMMISSION

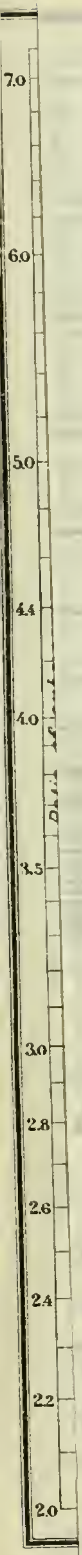
DIAGRAM SHOWING

EXPERIMENTAL COEFFICIENTS
OF
SUBMERGED WEIR
ALSO
CROSS SECTIONS OF
SUBMERGED WEIR MODELS
1912

PLATE VI



INTERNATIONAL WATERWAYS COMMISSION
CROSS SECTION OF
NIAGARA RIVER
SHOWING
NATURAL AND COMPENSATED STAGES
AT SITE OF
SUBMERGED WEIR
1912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4.4
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2.6
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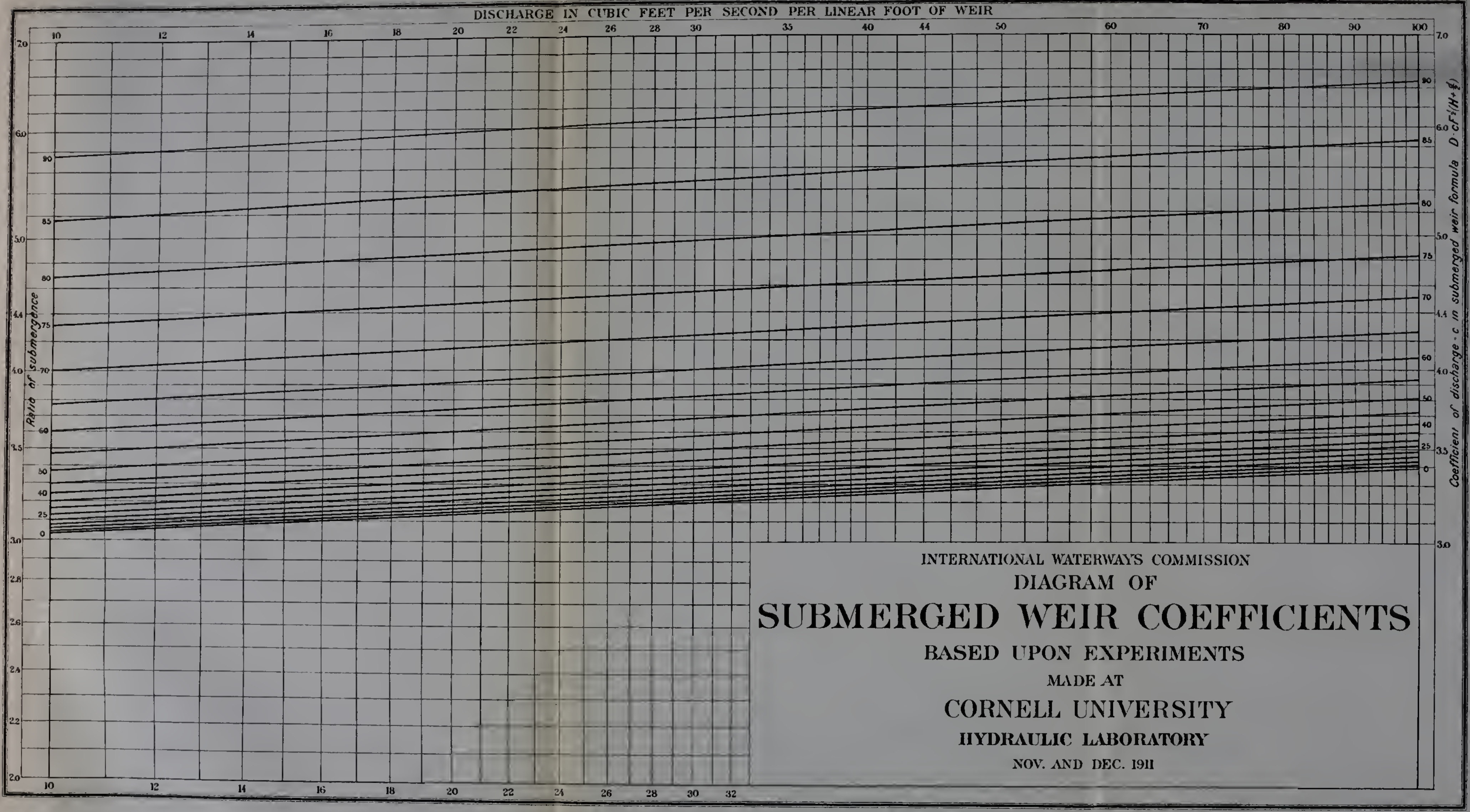
2.2
2.0



INTERNATIONAL WATERWAYS COMMISSION

DIAGRAM OF

SUBMERGED WEIR COEFFICIENTS

BASED UPON EXPERIMENTS

MADE AT

CORNELL UNIVERSITY

HYDRAULIC LABORATORY

NOV. AND DEC. 1911

ALPHABETICAL INDEX

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